MARCH 22, 1954

Electrical World

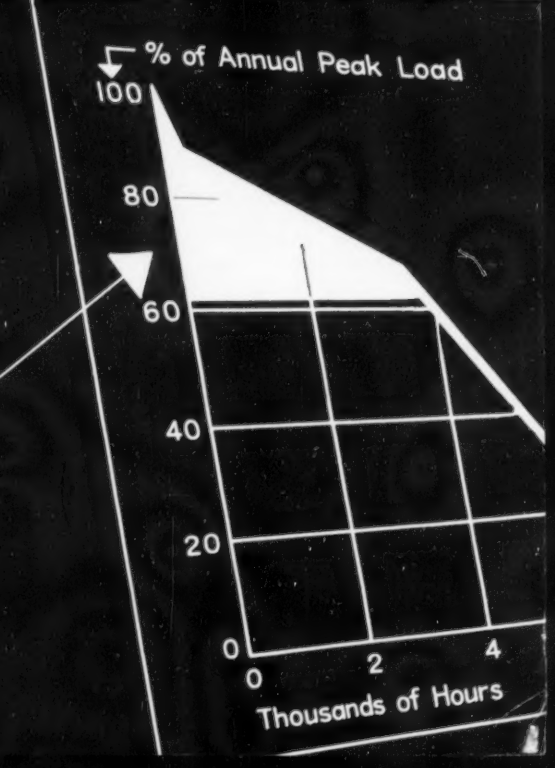
Price 35 Cents

A McGRAW-HILL PUBLICATION

Martins Creek:

Pennsylvania P&L's new outdoor station which will operate 4,000 hours a year at low incremental cost

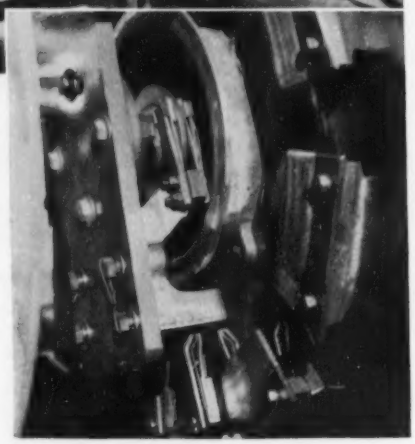
See Page 96



Allis-Chalmers Gives You

17 YEARS' PROOF

ALLIS-CHALMERS
5/8% STEP VOLTAGE REGULATORS



Practically No Wear After 1,240,000 Operations

Pictures above and at right show mechanism and contacts of an Allis-Chalmers power regulator that operated on a west coast utility for 17 years. You can see from these unretouched photos that nearly a million and a quarter operations resulted in practically no wear. This regulator is still in condition to provide many more years of satisfactory service.

You get operating records like this only from Allis-Chalmers. Twenty years of experience designing and building 5/8% step voltage regulators results in rugged construction and proved reliability. Laboratory tests, for example, show that the *Quick-Break* mechanism can withstand five million operations. The 17-year result shown above adds field proof to these laboratory tests.

Next time you consider regulation, for new or replacement installations, it will pay you to check the advantages of Allis-Chalmers regulators. For complete details on their design and construction see the A-C office nearest you or write Allis-Chalmers, Milwaukee 1, Wisconsin. A-4243

Three-Phase Power Regulator

Single-Phase Distribution Regulator

Single-Phase Power Regulator

ALLIS-CHALMERS

Originators of 5/8% Step Regulation

Meet This Week's Writers

Pennsylvania Power & Light Co's method of boosting system capacity with its outdoor Martins Creek plant is explained on page 96. The explanation is offered by Melvin D. Engle, mechanical engineering chief, Nicolas N. Smeloff, system planning engineer, and Stanley C. Townsend, electrical engineer.

M. D. ENGLE

Engle, entered the utility field after World War I when he joined Consolidated Gas, Electric, Light & Power Co of Baltimore. After serving with Boston Edison and War Production Board, he went in 1945 to PP&L.

Born and educated in Russia, Smeloff came to America in 1917 and four years later joined PP&L. He is married and has three children.

Townsend, who was educated at Lehigh University, became affiliated in 1924 with Pennsylvania P&L.

H. H. STROZIER B. H. SCHULTZ

A new concept in capacitor switching that cuts outlay is explored in an article on page 111 by H. H. Strozier, Georgia Power Co, and Blaine H. Schultz, Line Material Co.

A native of Newnan, Ga., Strozier was graduated in 1933 from the U. S. Naval Academy, Annapolis, Md., with a B.S. degree in mechanical and electrical engineering. Strozier joined Georgia Power's engineering staff after serving 17 years with the Navy.

Schultz, an electrical engineer, works in the Central Plant of L-M. He is married and has two children.

Electrical World

Published for 80 years for those engaged in the business of generating, transmitting, distributing, or applying electric power

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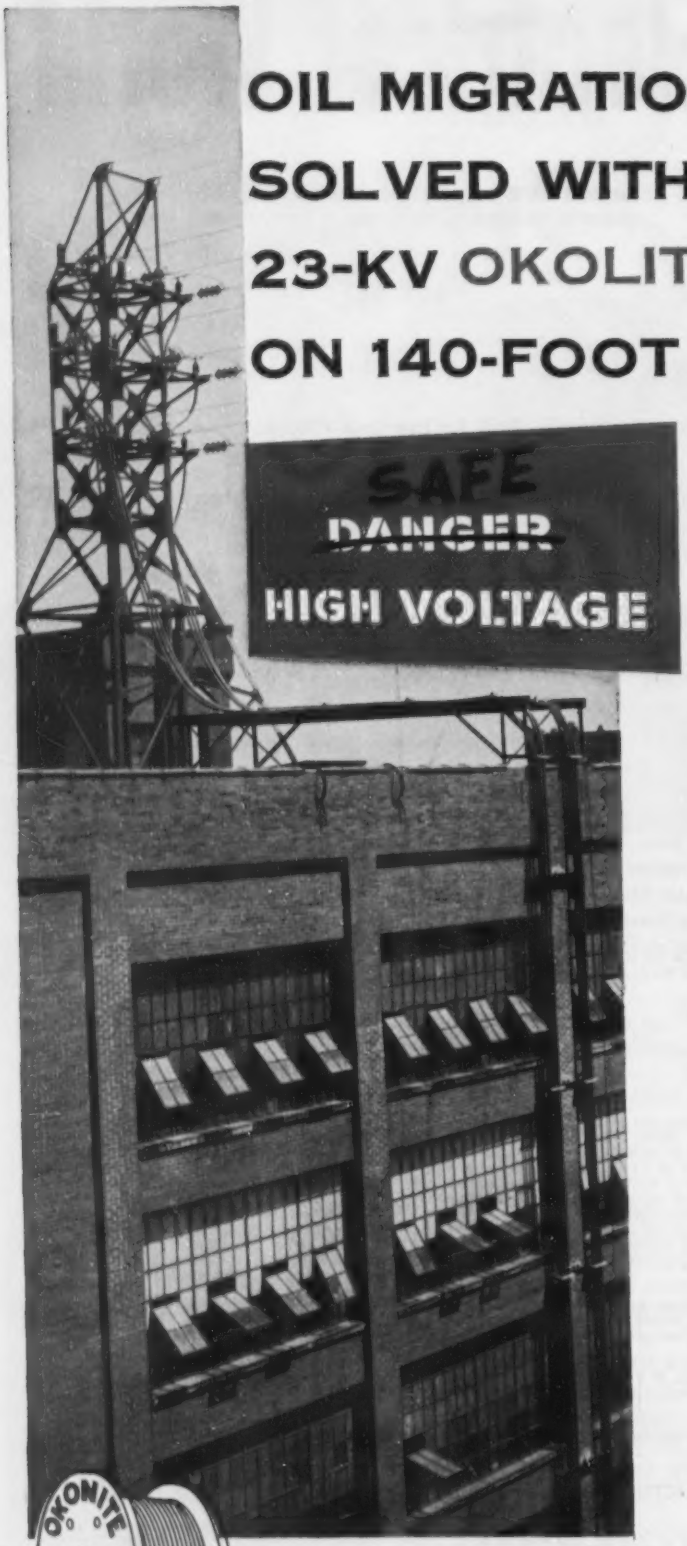
Published weekly by McGraw-Hill Publishing Company, Inc., James H. McGraw (1860-1948), Founder. Publication Office, 99-129 North Broadway, Albany 1, N. Y. Executive, Editorial and Advertising Office: McGraw-Hill Building, 330 W. 42nd St., New York 36, N. Y. Donald C. McGraw, President; Willard Chevalier, Executive Vice-President; Joseph A. Gerardi, Vice-President and Treasurer; John J. Cooke, Secretary; Paul Montgomery, Senior Vice-President, Publications Division; Ralph B. Smith, Vice-President and Editorial Director; Nelson Bond, Vice-President and Director of Advertising; J. E. Blackburn, Jr., Vice-President and Director of Circulation. Subscriptions: Address correspondence to Electrical World—Subscription Service, 99-129 N. Broadway, Albany 1, N. Y., or 330 W. 42nd St., New York 36, N. Y. Allow one month for change of address.

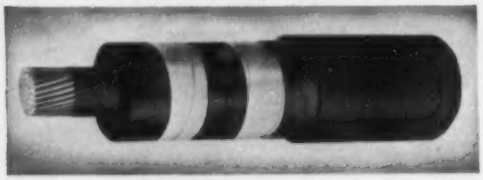
Subscriptions are accepted from executives, supervisory and engineering personnel in electric utilities, manufacturing companies, and related fields. Position and company connection must be indicated on subscription orders.

Single copies 35¢. For the United States and Possessions $6 a year, $9 for two years, $12 for three years. Canada, $7 for one year, $11 for two years, $14 for three years. (Canadian money, at par.) Other Western Hemisphere, $15 for one year, $25 for two years, $30 for three years. All other countries $25 for one year, $40 for two years, $50 for three years. Entered as second-class matter, November 16, 1936, at the Post Office at Albany, N. Y., under the Act of March 3, 1879. Printed in U.S.A. Copyright 1954 by McGraw-Hill Publishing Company, Inc. Permission required to reproduce any of contents.

OIL MIGRATION PROBLEM SOLVED WITH 23-KV OKOLITE-OKOPRENE ON 140-FOOT DROP



Paper-insulated, lead-sheathed cable, originally considered for vertical feeders at this midwestern plant because of low initial cost, was ruled out because high internal pressures due to oil migration might cause the sheath to burst. Instead, Okolite-Okoprene cable, with no oil to migrate, was installed. The cable, operating at 23 kv, ungrounded, with a vertical drop of 140 feet, is the primary circuit from utility substation to plant substation.



The elimination of the oil migration problem is just one of the important reasons for the strong trend toward Okolite-Okoprene rubber-insulated, high-voltage cables. Okolite-Okoprene cables are designed for ease of handling and simplicity of termination. Specialized personnel or equipment are not required for installation. There is an Okolite-insulated cable to meet your requirements for voltages up to 35 kv.

Bulletin EW-1075, the 128-page manual on high-voltage, rubber-insulated power cable design, includes installation practice as well as terminating and splicing procedures. Write for it on your letterhead to The Okonite Company, Passaic, N. J.

OKONITE SINCE 1878 *insulated cables*

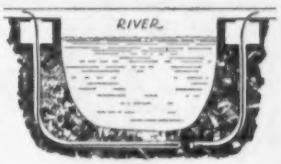
2208

10,000 FEET OF CONDUIT RODDED IN 8 HOURS!

Pick-up and Leader fittings meeting

Right, Electroline Steel Rodding Equipment feeds easily around the bends.

Below, Leader locked in Pick-up for either push or pull.



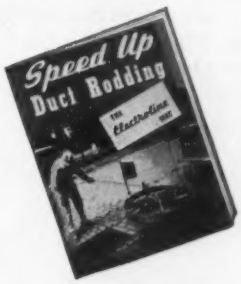
EASY DOES IT!—It's all in a day's work with Electroline Steel Duct-Rodding Equipment rodding 10,000 feet of conduit!

Light in weight, easily handled and stored, low upkeep: these are a few of the advantages utility men know to be true. But even bigger, more important advantages are—

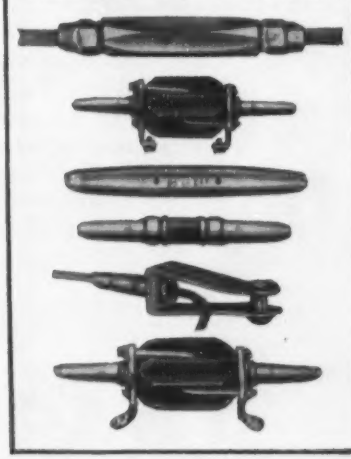
- *Savings in the cost of labor*—for example, where it formerly took two gangs from one to two weeks on a given job, one gang, *in one-half hour*, has completed the same job—using Electroline Duct-Rodding Equipment.
- *Savings in original cost*—you get long life—double that of other types—when you buy Electroline Duct-Rodding Equipment. Add to that this fact: this equipment costs just about half as much for equivalent capacity! *There's true economy.*
- *Savings in Total Investment*—fewer sets are required because of the speed with which a job is completed and the equipment moved to other locations.

Speed up installation, reduce your costs; start now to use Electroline Duct-Rodding Equipment. Available for 3", 3½" or 4" Duct.

We've got a 4-page brochure which describes and illustrates more completely how this equipment can benefit you. We'll gladly send you a copy. Write us.



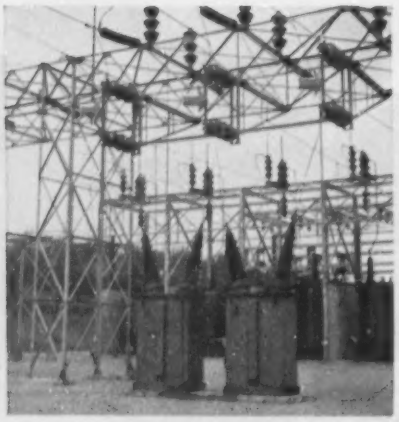
OTHER *Electroline* PRODUCTS



Electroline Company

4121 South La Salle St., Chicago 9, Ill.
In Canada: POWERLITE DEVICES, LTD., TORONTO

S&C does it



SMD-1 Fuses have been in actual field service since March, 1952. The fuses have had many occasions to clear faults, and have done so successfully in each case.

S&C leads the way with another great advance in the fusing art—a *500,000 kva* power fuse designed for application to primaries of power transformers tapped directly on transmission and subtransmission lines; it is also designed for station service and potential transformer protection, and for sectionalizing.

Announcement of the Type SMD-1 Power Fuse comes as the culmination of many years of research, engineering, laboratory and field testing. It marks another FIRST by those who pioneered successively such fuse advances as (1) stored energy for terminal separation, (2) nondamageable fusible elements, (3) dropout action, (4) the single bore principle in boric acid fuses, (5) carbon dioxide for arc extinction, and (6) stress cones to give high external flashover characteristics.

HOW THE TYPE SMD-1 POWER FUSE EVOLVED:

S&C's fusing FIRSTS—mentioned above—brought to the industry in 1945 a million kva dropout boric acid fuse suitable for use at transmission and subtransmission voltages. This fuse—S&C's Type SMD-2—had a technical excellence equal to the most advanced types of circuit interrupting devices.

The SMD-2 engineering achievements have now been extended by development of the SMD-1 Fuse which is designed to provide protection on transmission and subtransmission systems where faults do not exceed 500,000 kva.

The SMD-1 is available in ratings at 34.5 kv, 46 kv, and 69 kv. Complete information is contained in this new Catalog Section 261 . . . available on request.

SPECIALISTS IN HIGH-VOLTAGE

again!

The New

Type SMD-1 Power Fuse

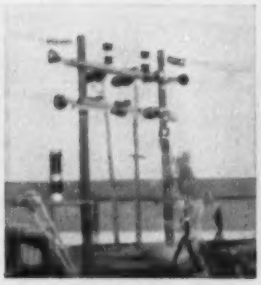
rated at

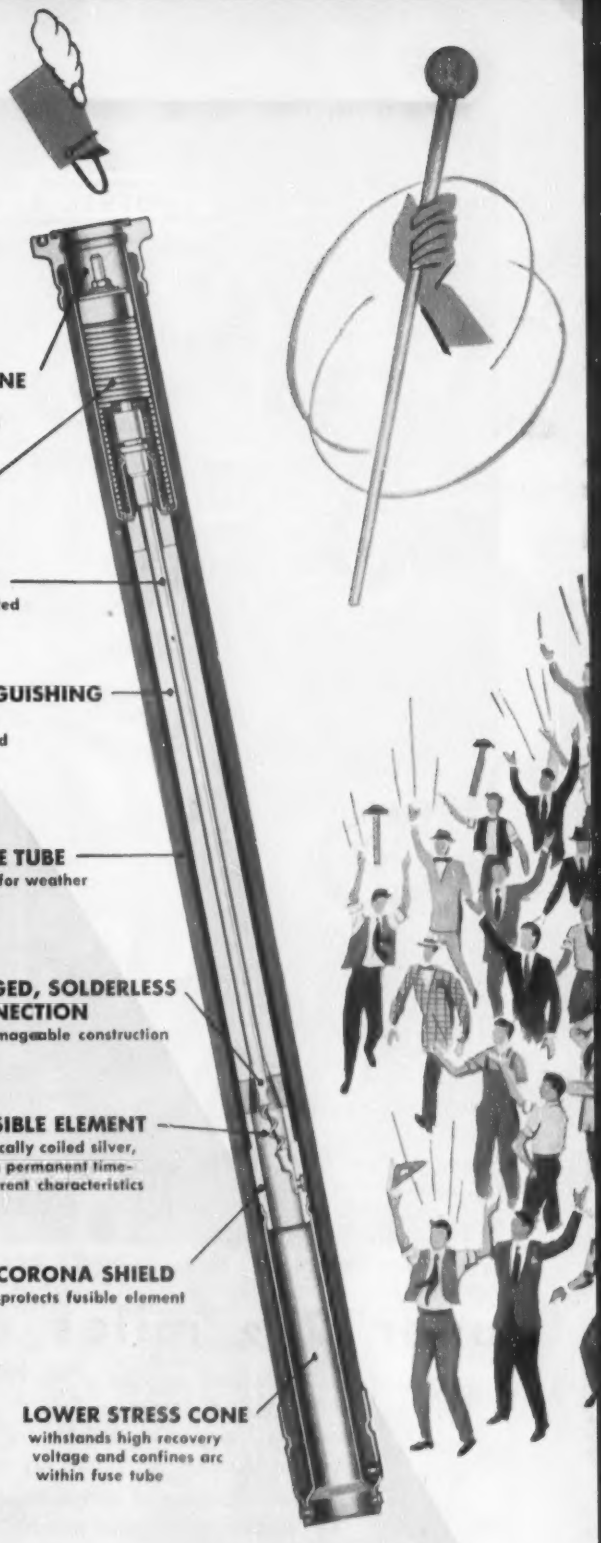
500,000 kva

3-phase

symmetrical

at 69 kv





HOW IT WAS TESTED:

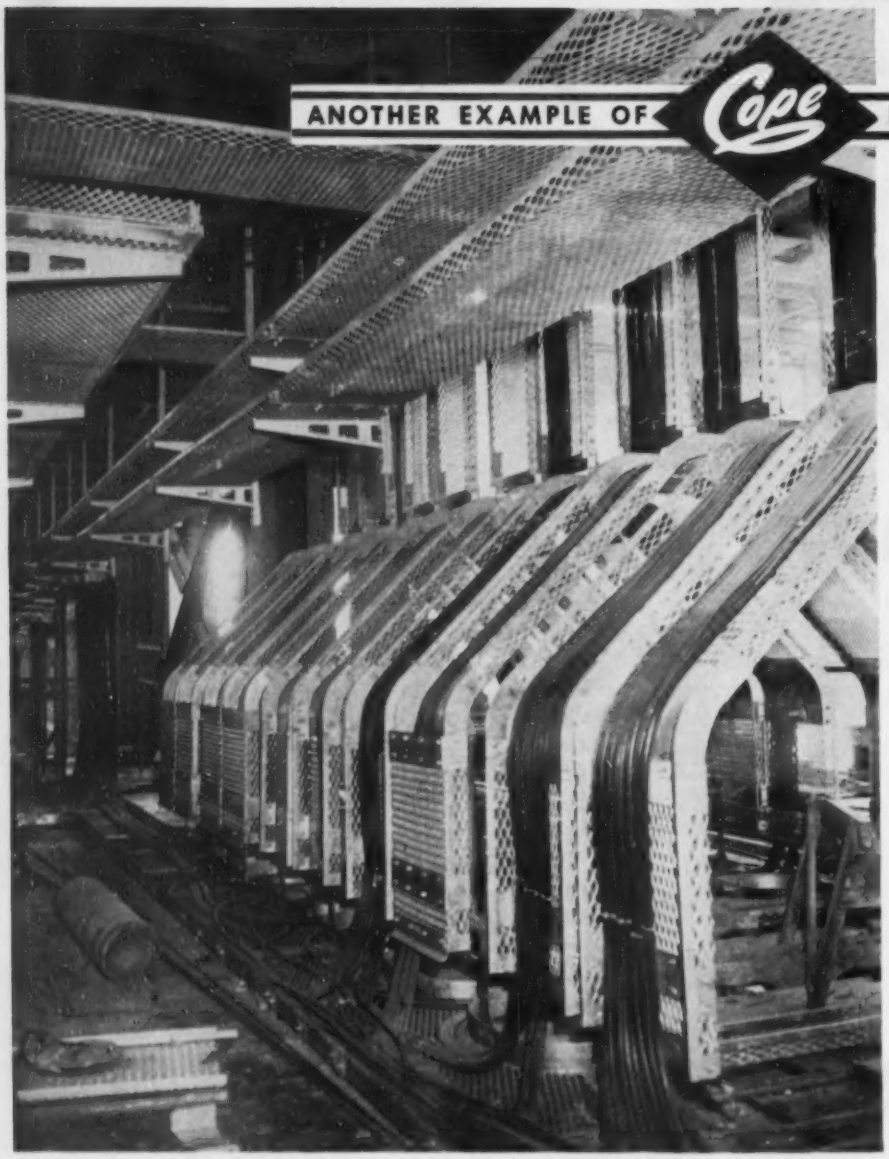
Type SMD-1 Fuse has been subjected to a unique testing program. It has had not only conventional laboratory tests but also very extensive field tests under a wide variety of circuit and fault conditions. Above is a snapshot of one of the more recent tests conducted in collaboration with engineers of a large eastern utility. Maximum fault interrupted: 560,000 kva symmetrical 3-phase at 66,000 volts.

S&C ELECTRIC COMPANY

4421 RAVENSWOOD AVENUE
CHICAGO 40, ILLINOIS, U. S. A.

IN CANADA: S&C ELECTRIC CANADA, LTD.
8 VANSCO ROAD, TORONTO 14, ONTARIO

CIRCUIT INTERRUPTION



Ohio Edison Company, Niles Station • Hatzel & Buehler—Electrical Contractors

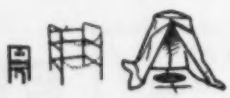
over 2½ miles of Cope Cable Trough

. . . has been installed in the Ohio Edison Company's new 212,000 kw. steam station at Niles, Ohio, to carry both auxiliary power and control circuits throughout this gigantic structure. All circuits are readily available for maintenance, and sufficient trough area remains for additional cables necessary for future expansion.

The simplification of design through the use of standard parts, plus the ease of installation and the low installed cost, make possible many savings which may be obtained through using COPE Cable Trough.

For further information, write today for Bulletin 3W.

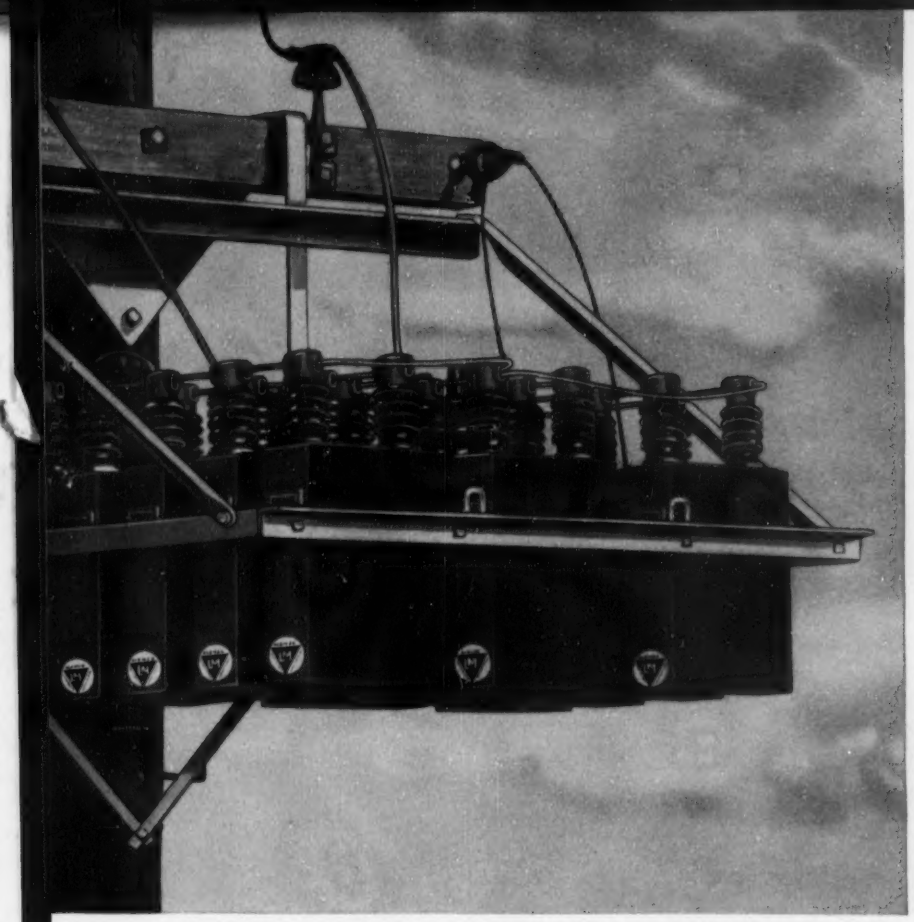
You know Cope by these products



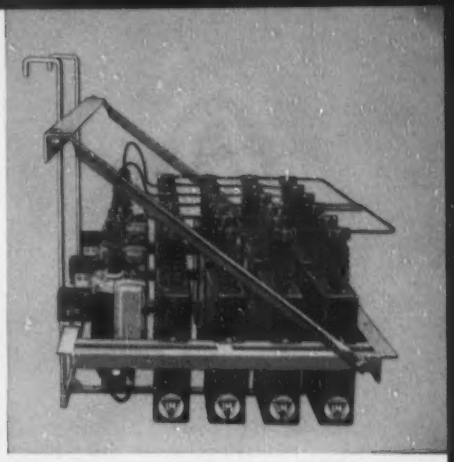
Cope

T. J. COPE, INC.

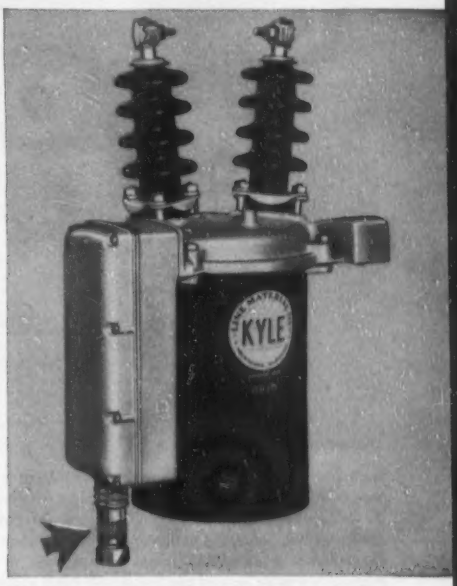
711 SOUTH 50th ST., PHILADELPHIA 43, PA.



A 300 kvar switched capacitor rack installation. Wiring is completely neoprene-jacketed and bird-proof. Racks are available with or without the three L-M Kyle Type NR Oil Switches.



Stress on the pole is no problem—less than one transformer and one secondary drop. Capacitors are mounted vertically—which provides compactness and longer capacitor life.



L-M Kyle Type NR Oil Switch. Only low-cost switch with 200 ampere thermal rating and full 150 ampere nominal capacitive rating at 15 kv. Weatherproof plug-in connection at the base of each oil switch control housing. This makes it easy to connect or disconnect the switch without disturbing any of the wiring. Only one easy-to-reach connection on each switch.

You Save 3 Ways With ELEMEX CAPACITORS

by **DANIEL J. J. PIRHOFER**, Sales Application Engineer, Capacitor Division, Line Material Company

Since utility systems install power factor correction equipment for its economic benefits, you might as well make the saving involved as great as possible. L-M's ELEMEX Capacitors offer 3 special savings:

1 You save on installation costs with completely assembled and factory-wired racks.

2 You save on over-all life cost because quality design and rigid quality control result in capacitors with an exceptional service record. Failure rate is less than one-half the national average.

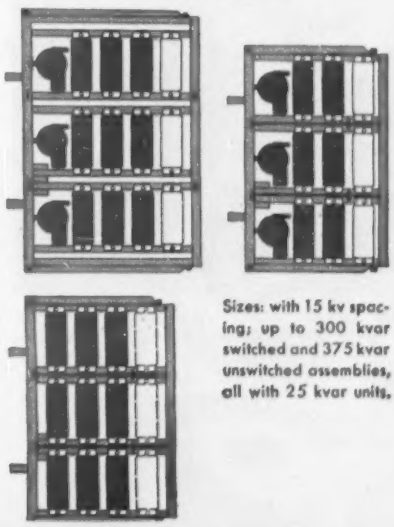
3 You save on automatic switching with L-M's simple, rugged, economical Voltage Control.

Racks and their features are illustrated above. The exclusive process that gives ELEMEX Capacitors such long life is shown on the next two pages. On the fourth page is the L-M Voltage Control. May we give you details? Ask the L-M Field Engineer for a copy of Bulletin PC-1—and, if you like, a copy of "ABC's of Capacitors." Or, write me at Line Material Company, Milwaukee 1, Wisconsin (a McGraw Electric Company Division).

148-1

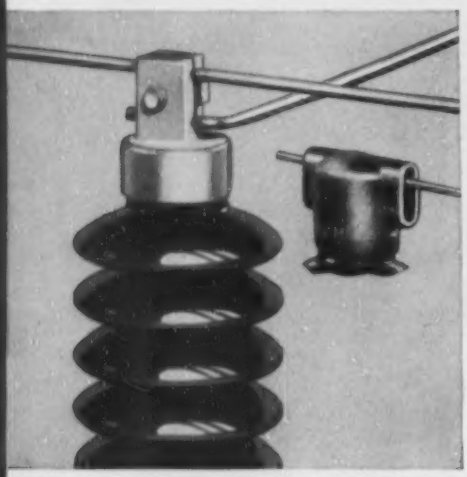
LINE MATERIAL

LM Elemex Capacitors

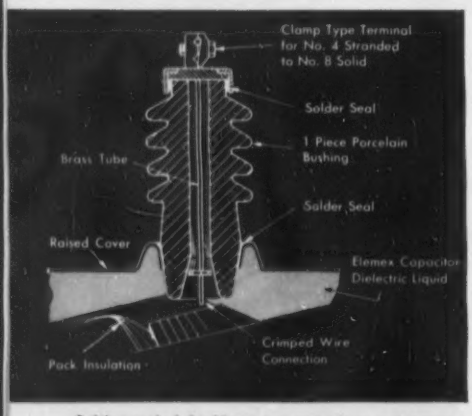


Sizes: with 15 kv spacing; up to 300 kvar switched and 375 kvar unswitched assemblies, all with 25 kvar units.

Every single pack is individually tested—with an over-voltage test that instantly reveals any actual and potential defects. Both faulty and marginal packs are rejected.



Exclusive "Paragroove" clamp-type terminal saves time and labor. Wire isn't threaded through a slot—it's just dropped in and clamped. Torque is vertical, not horizontal. Therefore in tightening you don't twist the bushing or stress the solder seal unduly. It's rugged; we've never had one break. No loose parts. Low resistance, less heating. Neoprene insulating caps also available.



Solder-sealed bushings are one-piece wet-process porcelain, with two metallized bands over the glaze. Bushings are hermetically sealed to drawn raised bosses in the cover that, shed water like a duck. Strong? It takes over 3000 pounds to force an L-M bushing out of the cover. And they're 100% pressure-tested—every single one!

Packs are wound by automatic machines in spotless, dust-free, air-conditioned rooms. Once the machine is set, it automatically winds the proper footage of paper and foil and locates the position for the electrodes. Thus, uniformity is assured. Paper is the highest-grade dielectric tissue, of 8/10ths density, which adds greatly to the very low failure rate of ELEMEX Capacitors.

L-M's Exclusive Process

The exceptionally long life of ELEMEX Capacitors is proved in the laboratory with accelerated life tests, and in the field under actual service conditions. In the accelerated life tests, ELEMEX Capacitors last twice as long as other capacitors. This is true—but why it is true is because of a number of things.

The fact that we use 8/10ths density paper is *important*. This density seems to yield better to impregnation, without being too porous, and gives a lower paper power factor. This results in better performance.

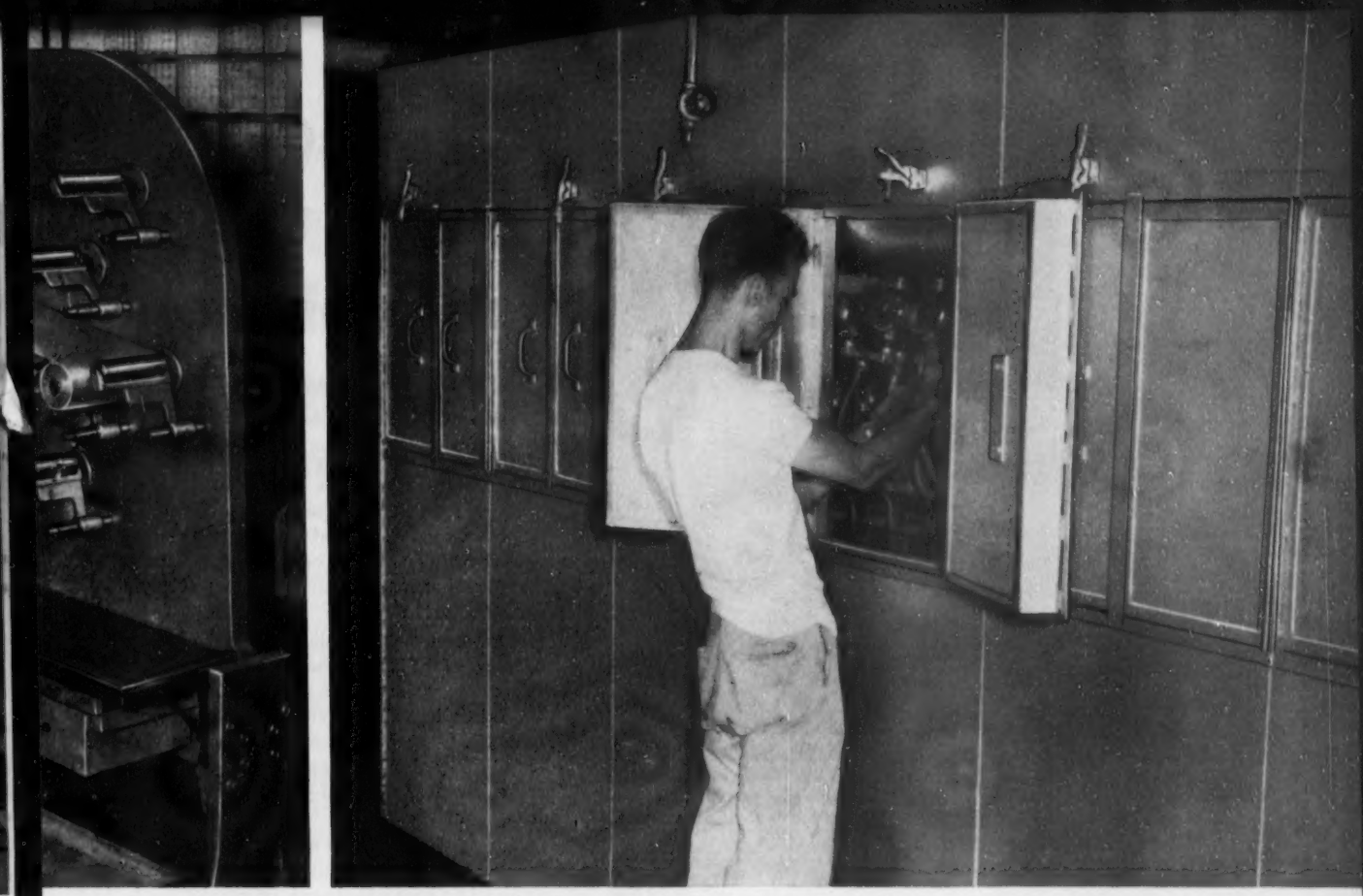
Another point is L-M's exclusive process of continuous, *individual* drying and impregnation. This is done with a very large-capacity high vacuum pump by means of individual capacitor connections, in an unsealed oven. Each unit is tested *during* the process.

Individual evacuation and testing assure that each capacitor becomes bone-dry, and that ELEMEX liquid slowly permeates every fibre of the paper. Even the bushings are completely filled with ELEMEX liquid, giving them exceptionally good electrical qualities.

The arc-welded tanks are designed to give the tank sides flexibility to allow for expansion and contraction of the ELEMEX liquid with changes in temperature. Tanks are sandblasted and then given three coats of baked enamel finish. The first coat is a red chromate primer, and the second and third coats are a melamine-modified alkyd resin enamel. This finish has been extensively tested under various weathering conditions. Severe atmospheric exposures such as coastal salt spray and sulphurous industrial conditions, and various laboratory tests, have proved the durability of the L-M finish as compared to other types of finishes.

ELEMEX Capacitors are outstanding in their performance and long life. L-M Field Engineers will be glad to supply additional data, details, and literature. Or write Line Material Company, Milwaukee 1, Wisconsin (a McGraw Electric Company Division).

"ELEMEX" is a Line Material trademark.



ELEMEX Capacitors are individually dried and impregnated in unsealed ovens like this. L-M evacuates only the *inside* of the capacitors, not the space around them. Air at controlled temperatures is circulated around the entire capacitor to maintain proper internal temperatures, giving better drying and complete impregnation. Also, the heat cures the paper, lowering its power factor and providing a low power factor in the completed unit. Each unit gets individual tests of power factor and capacitance during evacuation. These tests assure proper timing of each step in the process.

Reduces Capacitor Replacement

Tanks are sandblasted. Then they get a coat of red chromate primer, and *two additional* coats of melamine-modified alkyd resin enamel. Each coat is cured by baking.

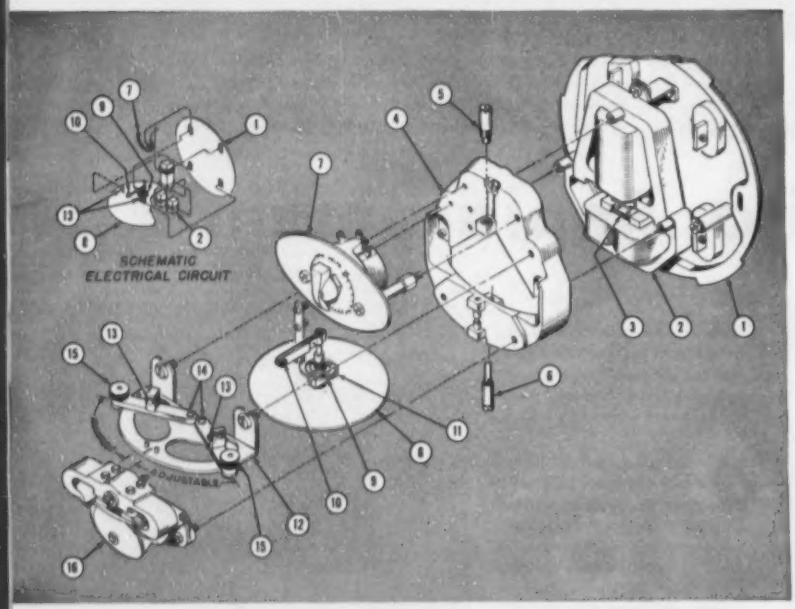
The completed capacitor. Its test record tag, which has followed it throughout the process, is filed. Stainless steel tank flanges carry the nameplate identification. All ELEMEX Capacitors have the same width and thickness. Hanger flanges are placed to provide uniform terminal elevation above the hanger in each voltage class. This makes it easy to change from 15 to 25 kvar, if desired.

148-2

LINE MATERIAL

Elemex Capacitors

L-M's Voltage Control. Nominal line adjustment, 110 to 130 volts. Band width adjustment, 12 volts maximum. Time delay, instantaneous to 4½ minutes with synchronous motor drive. Toggle switches permit automatic, test or manual operation. Weatherproof steel cabinet with 1-inch threaded pipe fitting and two multiple knockouts.



Contact-Making Voltmeter Components

1. Base Plate
2. Core and Coil Assembly
3. Temperature-Compensating Magnetic Shunt
4. Frame Casting
5. Upper Bearing
6. Lower Bearing
7. Nominal Voltage Adjustment Rheostat
8. Induction Disc Assembly
9. Current-Carrying Spiral Spring
10. Moving Contacts
11. Static Counterbalance
12. Stationary Contact Plate Assembly
13. Stationary Contact
14. Bakelite Arms
15. Knurled Clamping Nut
16. Damping Magnet Assembly

Low-Cost Voltage Control for Capacitors

L-M's Voltage Control is a rugged, dependable device that makes automatic capacitor switching economical.

The L-M Type CCV Voltage Control provides a simple, economical method for switching capacitors. It was designed to eliminate some of the difficulties inherent in balanced-beam solenoid types of controls.

Its low cost makes it possible to take greater advantage of the benefits that switched capacitors can provide. While the unit is designed to operate with L-M's Kyle Type NR Oil Switch (incorporated in L-M's pre-assembled capacitor racks) the CCV may also be adapted for use with other motor-driven or solenoid-operated equipment such as circuit breakers.

Heart of the control is a modified watt-hour meter which has been made volt-sensitive. This unit provides easy adjustment, permanent bandwidth settings, convenient size, simple installation, and low cost. The device provides approximately 3/16-inch contact travel per volt (120 volt base), assuring extremely sensitive operation. The voltmeter is temperature-compensated from minus 30 to plus 140 degrees F. Line voltage can be determined without the use of portable instruments. Once band width and midpoint settings are established, they remain fixed.

Let Us Send You Details

Ask the L-M Field Engineer for copy of Bulletin PC-1, which includes detailed description of construction and operation features; or write Line Material Co., Milwaukee 1, Wisconsin (a McGraw Electric Company Division).

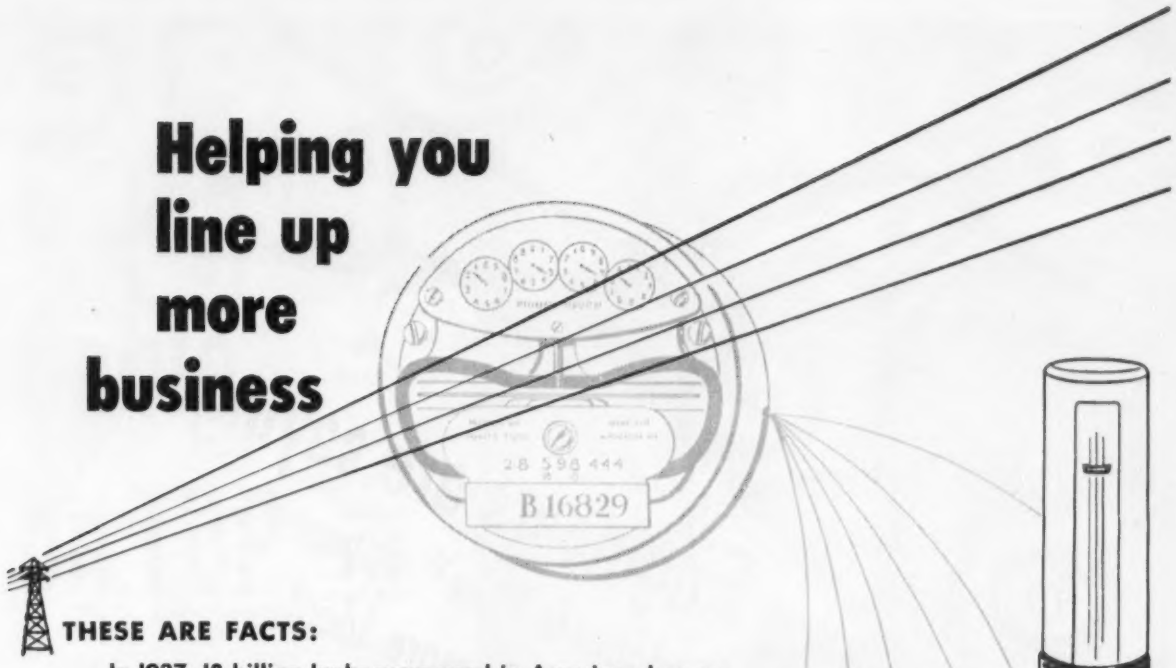
"ELEMEX" is a Line Material trademark.

148-3

LINE MATERIAL

Elemex Capacitors

Helping you line up more business



THESE ARE FACTS:

In 1937, 18 billion kwhr were used in American homes.
In 1953, over 95 billion kwhr were used.
In 1963—it is estimated that 226 *billion* kwhr will be needed to supply this same market.*

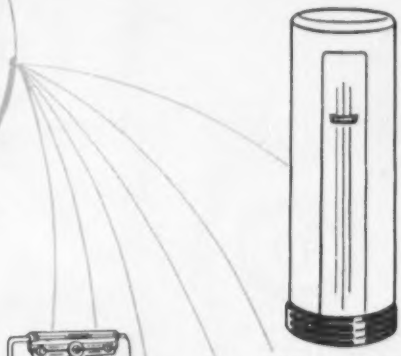
But, if residential needs for electrical energy are to climb to the predicted 1963 level, electrical appliance manufacturers and their promotional cooperation with local power companies will be of utmost importance. Manufacturers must have a sound plan that will sell the nation on the comfort, value and convenience of new and improved home appliances . . . on the advantages of electrical living.

The manufacturers of Crosley and Bendix Home Appliances *have* a plan. They have the know-how, capital, and facilities to carry it out. The recent consolidation of these two industry leaders is but *one* step in their gigantic program designed to increase sales of electric appliances.

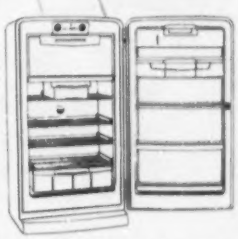
Bendix Home Laundries are in more wired homes than any other laundry unit. Crosley, of course, has been a pioneer in the electronics field and is one of the major producers of electric refrigerators (the famous Shelvador®), freezers, ranges, dishwashers, water heaters and other products. Crosley and Bendix, combined, *make and promote every major electrical appliance available.*

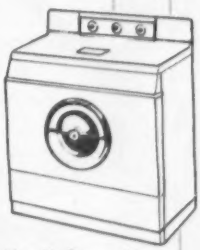
Would you like to hear more about how our plans will help *you*? Just call our distributor or write to: Utility Department, Appliance and Electronics Division, AVCO Manufacturing Corporation, 1329 Arlington Street, Cincinnati 25, Ohio.

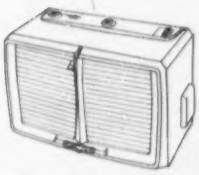
**Data, courtesy E. E. I. and* Electrical World.


Electric Water Heaters

Electric Ranges


Crosley Super Shelvador® Refrigerators


Bendix Duomatic Washer-Dryer


Room Air Conditioners

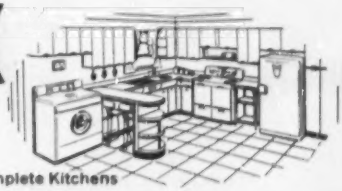
Dishwasher-Dryer

APPLIANCE AND ELECTRONICS DIVISION

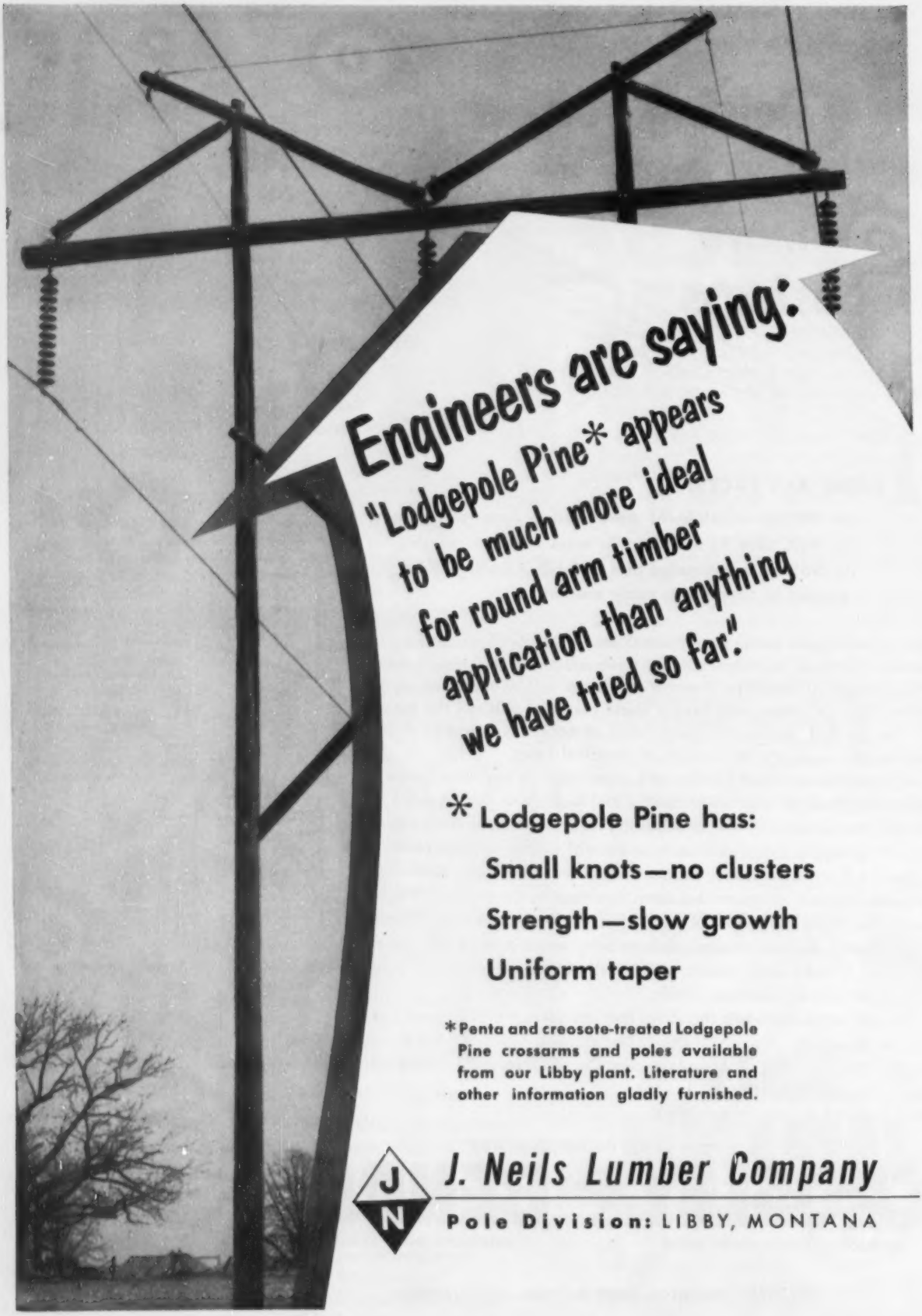
CROSLEY AVCO **BENDIX**

APPLIANCES • TELEVISION • RADIO

AUTOMATIC HOME LAUNDRY


Complete Kitchens

HELPING AMERICA LIVE BETTER—*electrically*



Engineers are saying:

"Lodgepole Pine* appears to be much more ideal for round arm timber application than anything we have tried so far."

*** Lodgepole Pine has:**

Small knots—no clusters

Strength—slow growth

Uniform taper

*** Penta and creosote-treated Lodgepole Pine crossarms and poles available from our Libby plant. Literature and other information gladly furnished.**

J. Neils Lumber Company

Pole Division: LIBBY, MONTANA

Burying Cable on TOP of the Ground

Recently an electric railway company decided on a line extension. Before they could lay the track they had to raise the grade of an existing roadway. Fortunately someone thought of burying the underground signal cable the easy way.

The electric railway scooped out a shallow depression, lined it with sand, put in the Simplex-ANHYDREX Signal Cables, covered them with sand, and then they filled the roadway to a depth of about four feet with fill. The top of the concrete pedestal will be at grade.

The electric railway showed good judgment on two counts. First, they buried the cable in the least expensive way and, second, they used Simplex-ANHYDREX Signal Cable which will give them dependable service for a long time to come.

Why did the railway buy ANHYDREX Signal Cables? Because the Anhydrex insulation will retain its electrical and physical properties indefinitely. This insures long life and dependable operation. The cable is easy to install, splice and terminate. It has no metallic sheath to crack from vibration or deteriorate from electrolysis. It does have a special metallic tape to resist termites, etc.

These are a few of the reasons why railways, public utilities and industrial plants are using ANHYDREX Cables for signal, control and communication services.

Simplex
WIRES & CABLES

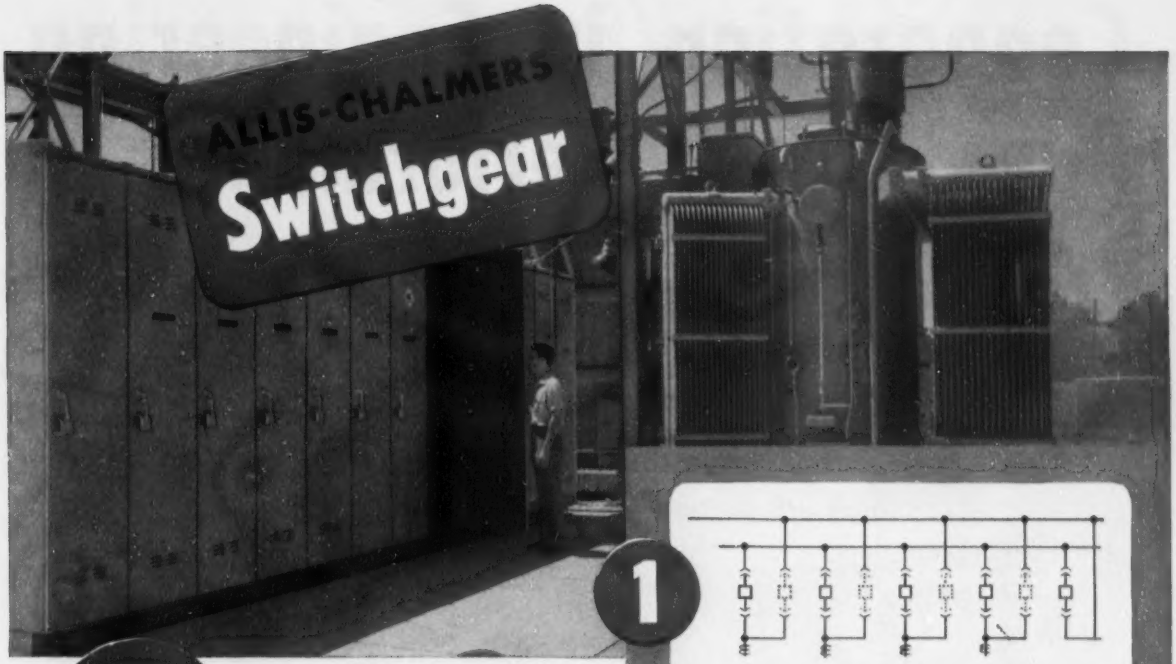
SIMPLEX WIRE & CABLE CO., 79 Sidney Street, Cambridge 39, Mass.

12 tons of force yet only 12 pounds of weight makes AMP's new hand hydraulic tool your best bet for rugged, dependable installation of these *precision-engineered* power terminals. Terminals and connectors are available in all ranges from #8 to #4/0. DESIGNED FOR USE ON ALL SHAPES OF WIRE: SOLID, STRANDED, SQUARE, OVAL, OR COMBINATIONS! Dies snap in and out easily. Tool automatically releases when crimping pressure is reached. Can be used with either pole strap or bench stand if desired. WRITE FOR SPECIAL POWER TERMINAL CATALOG.

AMP Trade Mark Reg. U.S. Pat. Off. © AMP

AMP

AIRCRAFT-MARINE PRODUCTS INC.
POWER TERMINAL DIVISION
2100 Paxton Street, Harrisburg, Pa.



4 WAYS to Guard Against Power Interruption

Here are a few of the many different circuit arrangements Allis-Chalmers can provide. All are designed to assure continuity of service. Each one is specially suited for specific situations.

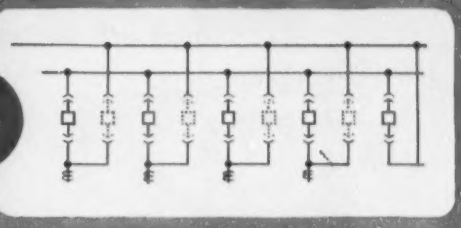
With Allis-Chalmers switchgear, all these circuit schemes have one advantage in common. Each arrangement shown can be built into standard units of Allis-Chalmers metal-clad switchgear without adding extra cubicles. This economy and simplicity, plus the obvious space savings, make Allis-Chalmers equipment especially attractive.

Which Arrangement is Best? A study of your problem is needed to answer this question. Any one of these arrangements may be best for your plant. Or maybe an entirely different scheme is needed. In any case, Allis-Chalmers engineers can help you work out the best scheme for you... one that provides ✓ economy, ✓ simplicity, ✓ space saving, and ✓ uninterrupted service.

For complete information, call your nearby A-C district office, or write Allis-Chalmers, Milwaukee 1, Wisconsin.

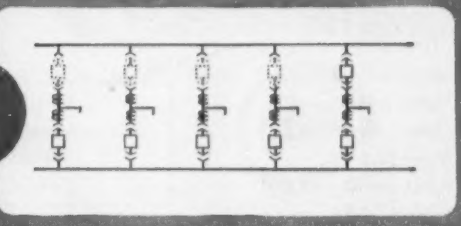
A-4165

1



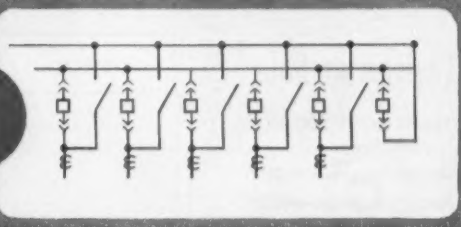
DOUBLE BUS in line

2



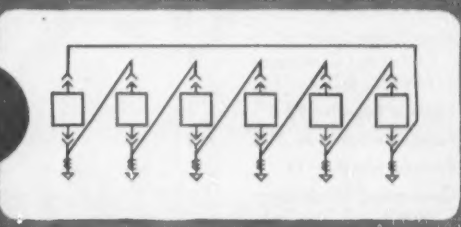
DOUBLE BUS back-to-back

3



TRANSFER BUS and disconnect

4



RING BUS

ALLIS-CHALMERS

Cooperation in Engineering Pays Off in Performance at ALBRIGHT STATION

Monongahela Power Co. — The Potomac Edison Co.

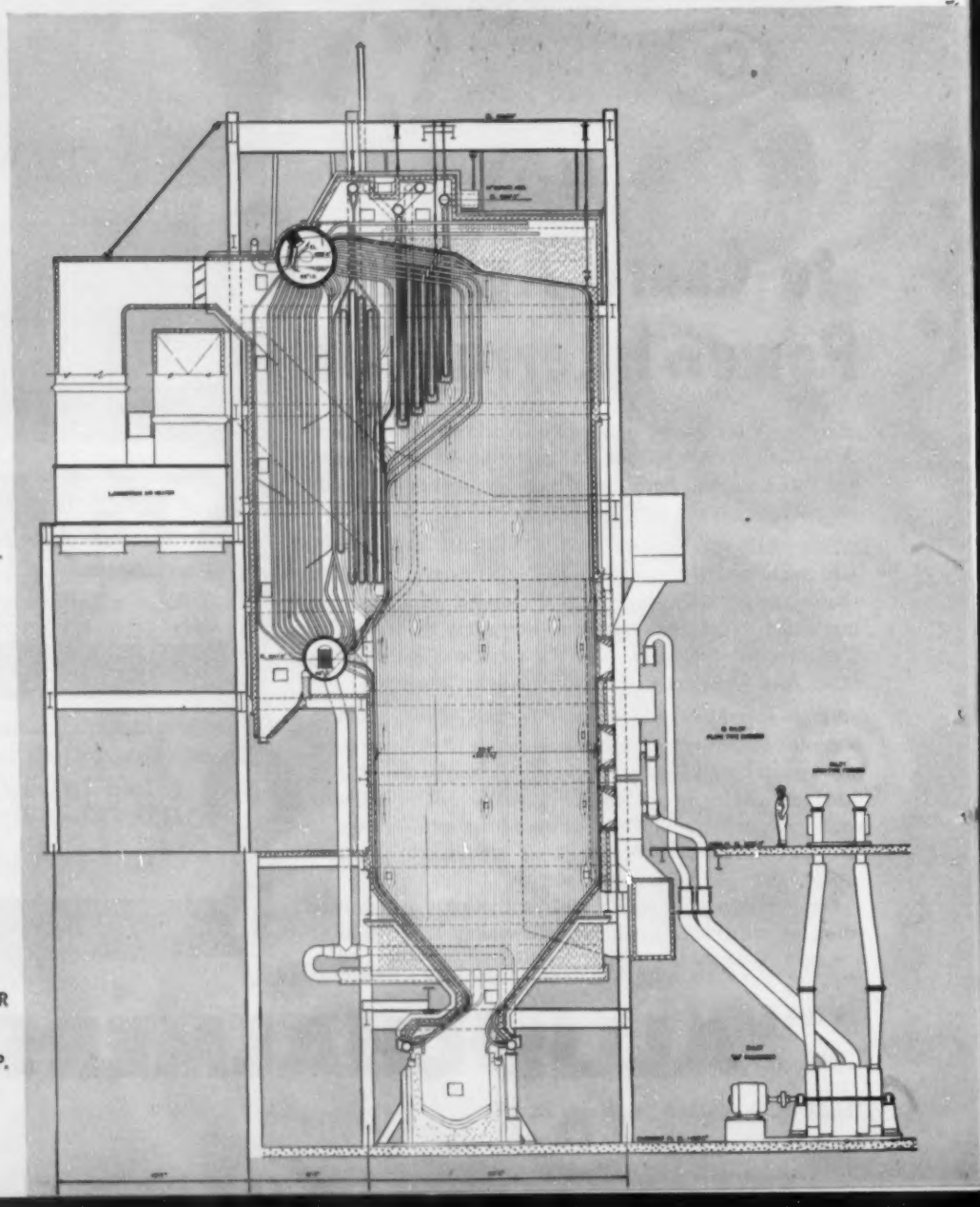
Special design considerations necessary to burn the low cost high ash portion of West Virginia deep and strip mine coal.

Analysis of Average Fuel

Moisture—4.7
Volatile Matter—25.2
Fixed Carbon—49.6
Ash—20.5
B.T.U. per lb.—11,570
Sulphur—2.54

Engineering Data

Two Riley 700,000 lbs./hr. units
Design Pressure—1050
Steam Temperature 905°F.
Heat Release per Cu. Ft. of Furnace Volume—19,600 B.T.U.
Heat Release per Sq. Ft. of Furnace Envelope—104,000 B.T.U.
Furnace Length—22'6"
Furnace Width—36'3⅜"
Furnace Height—72'
Guaranteed Efficiency—86.8%
Actual Efficiency—88%

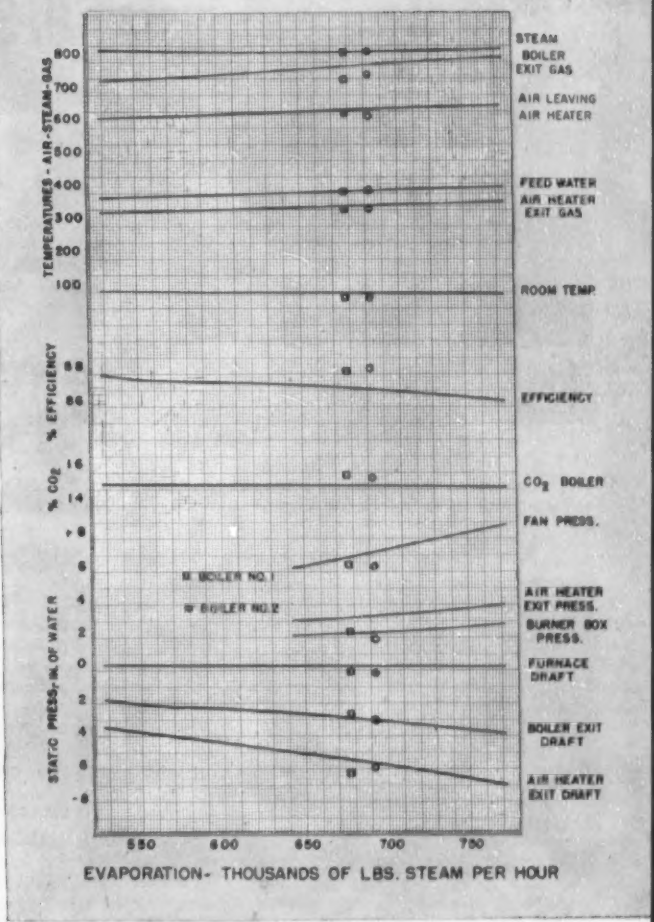


SANDERSON & PORTER
ENGINEERS

RILEY STOKER CORP.
WORCESTER, MASS.

Sitting literally on top of their West Virginia strip and deep mine coal supply, two Riley Steam Generators operate continuously at peak load day in and day out. Since the first of these two 700,000 lbs. per hour Riley units went on the line October 27, 1952, over 800,000 tons of this coal have been pulverized and burned. The heavy operating demand, plus the very nature of the coal—18.7% to 20.5% ash with softening temperature from 2100°F. to 2280°F.—meant that special considerations in design were necessary in order to avoid serious slagging. Close cooperation between the engineers of the Monongahela Power Co. and The Potomac Edison Co., Sanderson and Porter and Riley resulted in a design that features a heat release in the furnace of 19,600 B.T.U. per cu. ft. per hour with heating surface disposed to keep gases entering the screen tubes down to 2000°F. This design has produced higher than guaranteed efficiencies, which, with sustained high loads, makes possible low cost kilowatt production with turbines operating at maximum capacity.

Three Riley 550 series pulverizers fire each unit through twelve Riley flare type burners. Each pulverizer has a capacity of 40,000 pounds of coal per hour. Station engineers report, with water actually dripping out of pulverizer feeders, the flash drying characteristic of the feeder crusher-dryer sections of Riley's pulverizers dries coal so efficiently that pulverizer capacity is unaffected. Pulverizers are vibrationless and noiseless, and are equipped with Riley tungsten carbide grinding surfaces.



TRADE MARK Rx REGISTERED

RILEY STOKER CORPORATION

WORCESTER, MASS.

Boston, New York, Philadelphia, Buffalo, Washington, Pittsburgh, Cleveland, Detroit, Chicago, Cincinnati, Charlotte, New Orleans, Atlanta, St. Louis, Kansas City, St. Paul, Tulsa, Houston, Denver, Salt Lake City, Los Angeles, San Francisco, Portland, Seattle

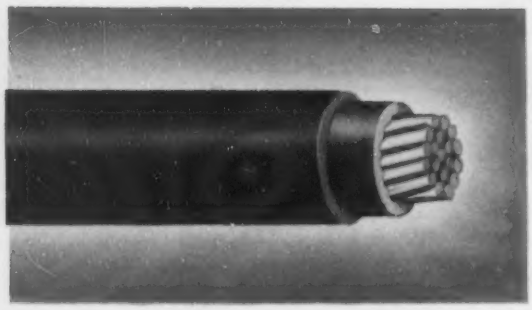
COMPLETE STEAM GENERATING UNITS

BOILERS • PULVERIZERS • BURNERS • STOKERS • SUPERHEATERS • ECONOMIZERS
WATER-COOLED FURNACES • STEEL-CLAD INSULATED SETTINGS • AIR HEATERS

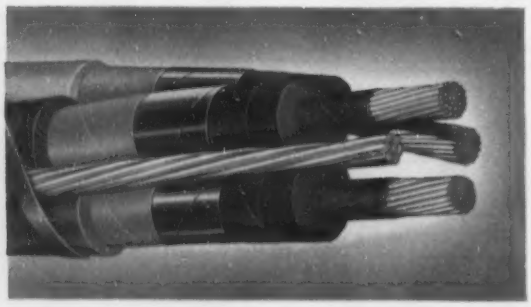
10 reasons why

you should specify, buy,

install U. S. GRIZZLY® POWER CABLES



U. S. Grizzly Power Cable, 600 volts – Type RR single conductor, Hydrosec® – S heat- and moisture-resistant insulation, Neoprene jacket.



U. S. Grizzly Power Cable, 15,000 volts – Type RR – 3-conductor, Uskorona® – ozone-resistant insulation – shielded – Neoprene jacket.

1. Lighter in weight than lead-sheathed cables and lead-sheathed armored cables.
2. Greater flexibility
3. Easier to handle during installation
4. Easier to splice, tap and terminate
5. More resistant to chemical corrosion
6. Unaffected by stray currents
7. Better protection against weathering
8. Longer life
9. Cost less
10. Made by United States Rubber Company, the *only* electrical wire and cable producer to grow its own natural rubber, make its own synthetic rubber and manufacture its own plastics

U. S. Grizzly Power Cables are used for general power distribution, and can be installed in conduits, underground ducts, buried directly in the ground, or installed aerially. Neoprene jacket protects against acids, alkalies, oils, and mechanical damage and weathering. (All IPCEA and NEMA specifications complied with.)

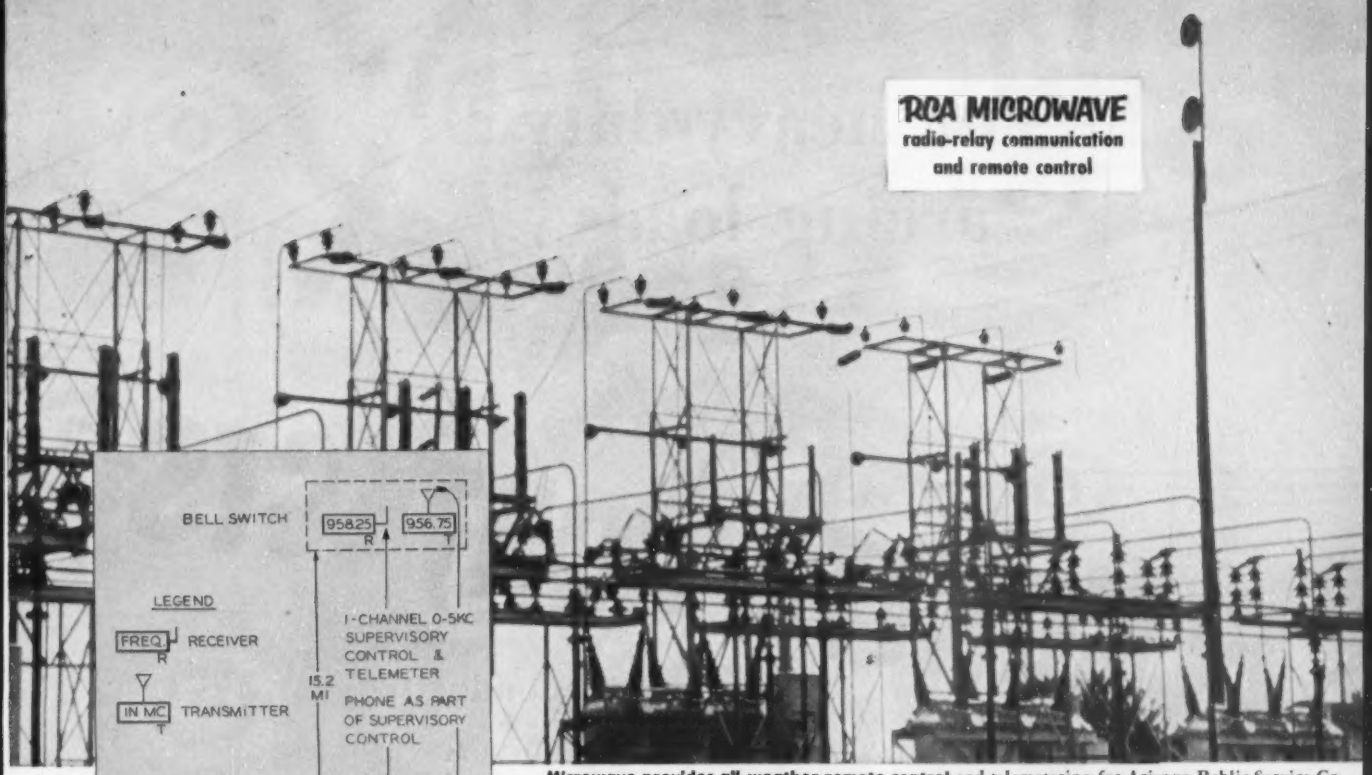
Write to address below for free copy of illustrated reference manual on U. S. Electrical Wires and Cables for the electric utility industry. It lists the type of cable best suited for specific requirements.

US RUBBER

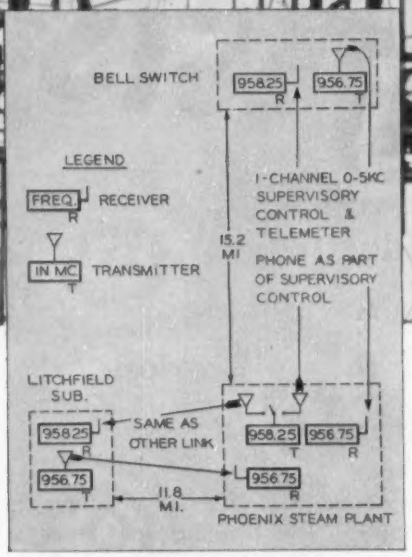
UNITED STATES RUBBER COMPANY

ELECTRICAL WIRE AND CABLE DEPARTMENT, ROCKEFELLER CENTER, NEW YORK 20, N. Y.

RCA MICROWAVE
radio-relay communication
and remote control



Microwave provides all-weather remote control and telemetering for Arizona Public Service Co. Unattended substations receive control impulses from steam plant at Phoenix



Arizona Public Service Co. 960-mc Microwave system. Selector switch connects transmitter to either antenna at Phoenix steam plant

Through severest heat, sand, electric storms . . . Arizona Public Service Company's remote supervisory control system (via Microwave) stays on the job

Since 1949 Arizona Public Service Company has used RCA Microwave for remote supervisory control of two substations from a steam-electric plant. One installation provides remote control and indications on five 69-kv breakers, telemetering of voltage and current, and a 2-way voice channel. The other installation controls two breakers and provides telemetering and voice channels between plant and switching station. (*See schematic.*)

Four years of operation under trying conditions have proved the reliability of RCA Microwave. Through ambient 140-degree heat, high winds, severe sand and dust storms, violent rain and electric storms—Public Service's supervisory control system stayed on the job. Here was a link which was independent of the transmission lines it services . . . providing reliable communications and control when needed most.

MANY ENGINEERING ADVANTAGES

Sound engineering features led Public Service to select microwave rather than high-line carrier. Microwave offered good noise and distortion characteristics, easy tie-in with mobile radio, greater channel capacity, reasonable freedom from interference, and relative ease of maintenance.

The economy factor also favored RCA Microwave. While a one-channel microwave system generally costs more than carrier to install, *in this particular case* it cost $9,000 less because crowded carrier frequency space would require considerable new equipment. In addition, RCA Microwave's built-in provisions for extra channels make it the *least expensive form of communication per channel mile.*

A PRACTICAL SYSTEM

Outage time of RCA Microwave is next to zero. "Dish" antennas beam highly directional radio signals from one relay station to the next. The radio transmissions follow a line-of-sight path—can approximately parallel power lines. Equipment uses easy-to-service familiar circuits and readily available tubes. It can interconnect with existing telephone lines, switchboards and mobile radio installations. One RCA Microwave system will handle up to 25 voice channels (or 25 x 18 telemetering and control channels).

You can prepare now for your expanding communications needs, *before they develop.* The booklets listed below provide quickly digested facts to help with future planning. *Mail the coupon—there's no obligation on your part.* And remember, the RCA Service Company provides nation-wide installation and service facilities.

RADIO CORPORATION of AMERICA
COMMUNICATIONS EQUIPMENT CAMDEN, N. J.

Dept CC-45, Building 15-1

Without obligation on my part, please send me your *free* booklet on: ☐ Microwave for Telemetering and Supervisory Control ☐ Electric Utility Microwave Systems

Name_____ Title_____

Company_____ Address_____

City_____ Zone_____ State_____

☐ Have an RCA communications specialist get in touch with me

For heavy-duty arcing loads....

Specify

ELKONITE® CONTACTS

- Good Conductivity
- Resistance to Sticking
- Resistance to Arc Erosion
- Impact Strength

Elkonite Contacts combine these characteristics in a way that can't be equalled...

Elkonite is the registered trade mark for a series of unique materials developed by Mallory, and manufactured from metal powders. The Elkonite process combines metals which will not alloy, producing new materials with properties often superior to their constituents.

Elkonite combines the arc-resistance of tungsten, molybdenum, or their carbides with the high current-carrying ability of copper or silver. Thus, Elkonite Contacts give excellent service under heavy-duty arcing loads where other materials would fail.

The secret of Elkonite superiority is the *technique by which the materials are combined.* Specifying an equivalent chemical composition will not assure the same physical properties. For dependable service in all heavy-duty circuit interrupting equipment, specify Mallory Elkonite Contacts. The Elkonite family of materials includes a variety of compositions for a wide range of contact requirements.

In Contacts . . .
Expect More . . . Get More
from **MALLORY**

NEW CONTACT CATALOG

Write for your copy today. It includes a discussion of Mallory materials and facilities for producing contacts and contact assemblies for every service . . . as well as valuable technical and design data.

Serving Industry with These Products:
Electromechanical—Resistors • Switches • Television Tuners • Vibrators
Electrochemical—Capacitors • Rectifiers • Mercury Batteries
Metallurgical—Contacts • Special Metals and Ceramics • Welding Materials

P. R. MALLORY & CO. Inc.
MALLORY
P. R. MALLORY & CO. Inc., INDIANAPOLIS 6, INDIANA

how to save $100
--by using Copperweld Strand here!
Copperweld Strand is permanently protected against corrosion. Each wire has a thick Copper Covering inseparably Molten-Welded to a strong Alloy Steel Core.
Copperweld TRADE MARK NON-RUSTING GUY and MESSENGER Strand
Costs Less because it Lasts Longer

You save money by using non-rusting Copperweld* Strand because you pay for only one guy installation during the life of the pole — costly replacements are eliminated. Certainly, this is important — for to replace just one rust-weakened or broken ordinary guy may cost you $100 or more, when you figure the outage and the items of labor, fittings and truck time—plus the cost of the new strand.

Once you put Copperweld Strand up, it's up to stay—its original high tensile strength remains permanent When you consider its extra staying power, longer life and low overall cost, Copperweld is the most dependable and economical strand you can buy.

So, when it comes to guying, why not start economizing now by standardizing on Copperweld Strand all along your lines? Engineering Data will be sent you on request.

*Trade Mark

COPPERWELD STEEL COMPANY

WIRE AND CABLE DIVISION Glassport, Pa.

SALES OFFICES IN PRINCIPAL CITIES

For Export: Copperweld Steel International Company, New York

new Thomas "Chip-Proof" insulator

A new corrugation design positively prevents chipping or breaking of inner petticoats. This protection is assured by eliminating the destructive bumping of caps or clamp fittings against the petticoats, yet gives complete interchangeability with all current designs as required by NEMA Standards. Only this new Thomas design (Patent applied for) can guarantee the virtual impossibility of damaging inner petticoats by rough handling during assembly or disassembly in the field.

• Naturally, we are excited. We believe our new petticoat design to be the answer to the insulator breakage problem, during construction, which has plagued the Industry for years. This design accomplishes positive elimination of insulator breakage during construction due to rough handling in coupling and uncoupling insulator units and in installing hardware fittings to the insulator strings.

Of course, the greatest benefit of this new design will be realized with the close-coupled units, but for all insulator spacings, our new design assures more ruggedness with resulting longer life . . . and at no additional cost to you!

The foregoing are bold statements. However, our most severe tests prove them and they are too important for you not to verify.

We suggest that you order TODAY, a standard crate of 6—No. 21239 THOMAS 1953-DESIGN SUSPENSION INSULATORS. Test them thoroughly . . . and compare with other close-coupled designs.

The R. Thomas and Sons Co.

1873 THOMAS INSULATORS our 81st year RELIABILITY 1954

LISBON, OHIO
NEW YORK CHICAGO

Sales Representatives: **C. G. Andersen, *Chicago* • E. B. Anderson Co., *Detroit* • Conrad R. Bangh, *Omaha* • Ken H. Best, *Seattle* • Nellis B. Bronner, Jr., *Syracuse* • R. E. Cunningham & Son, *Los Angeles* • W. H. Eddy Electric Products, Inc., *Phoenix* • Engineer Sales Co., *St. Petersburg* Electrical Distributors Co., *Philadelphia* • Hamilton Associates, *Denver* • Geo. E. Honn Co., *San Francisco* • Hugo Sales Co., *Minneapolis* • J. P. Lane Co., *St. Louis* • John G. Pettijohn Co., *Knoxville* • H. E. Ransford Co., *Pittsburgh* • J. F. Schaefer & Co., *Kansas City* • R. J. Sullivan Co., *Boston* Tafel Electric & Supply Co., *Louisville* • Walter E. Thompson Co., *Birmingham* • Triangle Electric Supply Co., *El Paso* • United Electric Supply Co., *Salt Lake City* • Williamson Sales Co., *Shreveport, Amarillo, Corpus Christi, Dallas, Houston, New Orleans, Pine Bluff* • *Representatives in other principal cities***

eliminate *Impact*

and you eliminate breakage

For many years, The R. Thomas and Sons Company has been well aware of the insulator breakage problem during construction. But none of us imagined the solution to be so simple and yet so effective.

Examine carefully the two drawings above. Note that with the OLD design (illustrated at the left) when the lower insulator is uncoupled, it can easily be SLAMMED directly in a straight line against the innermost petticoat. Obviously, this action results in a chipping or breaking IMPACT.

Now note how the THOMAS DIVERTER skirt (illustrated at the right above) eliminates impact. This DIVERTER skirt (Patent applied for) is simply a heavy corrugation designed with a contour that *diverts* the lower insulator or fittings away from any petticoats.

No matter how roughly the insulators are handled, when the cap is pulled off the ball pin, it will first strike the DIVERTER which it cannot break. This glancing blow will deflect any destructive IMPACT from the lighter petticoats. Simple . . . but EFFECTIVE.

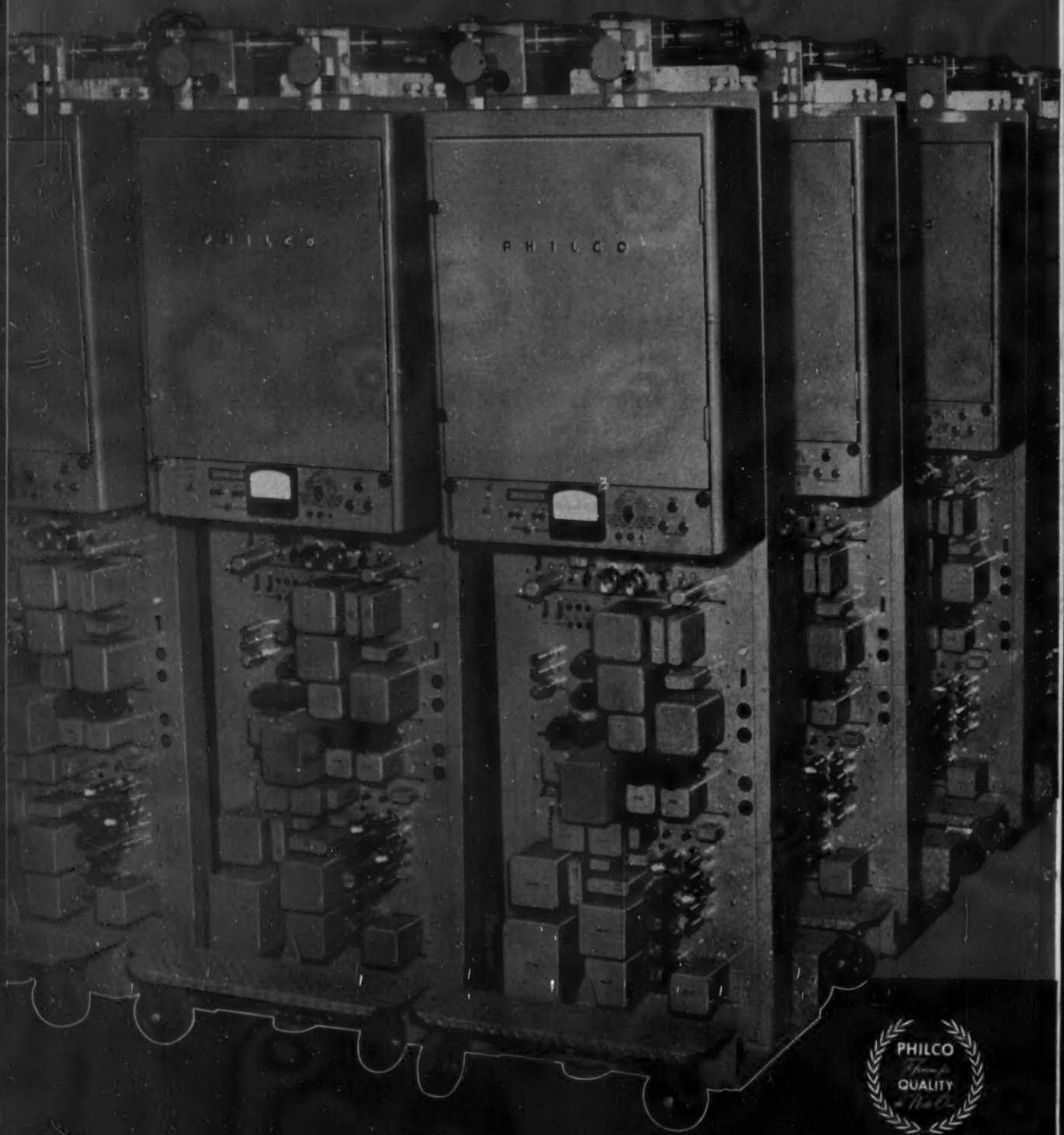
All standard Thomas 10-inch suspension insulators now have this feature . . . at no extra cost.

Specify **THOMAS INSULATORS—THE BEST BY LINE TEST**

The R. Thomas and Sons Company is a manufacturer and designer of all types of porcelain insulators . . . pin-type, switch, suspension, spools, guy-strain, bushings and special high-voltage porcelain. In addition, Thomas supplies associated line hardware, clamps, fittings, and so on.

PHILCO...

...HAS BUILT AND SHIPPED OVER



PHILCO
Symbol of
QUALITY

1000 MICROWAVE EQUIPMENTS

More than ALL OTHER Manufacturers Combined!

As the world's leading supplier of microwave, Philco has manufactured and delivered nearly 1400 complete microwave equipments...enough to span the nation five times—*or to privately link New York and Hong Kong!* Philco has built and shipped more microwave systems than all other manufacturers combined.

Philco has the distinct advantage of a world-wide installation and service organization, and an experienced system-planning department. These valuable facilities enable Philco to obtain first-hand information on the operation of existing installations, improve equipment, and thus supply new microwave systems which assure the greatest economy and dependability in performance.

This is one reason why Philco microwave is the preference of industry—*good reason why Philco is the world's leading manufacturer of microwave equipment.*

Need a speedy and permanent cure for those communication headaches? Then consider microwave . . . and when you do, specify Philco. An experienced Philco representative is ready to serve you.

World's Leading Manufacturer of Microwave Equipment!

For complete details, write to Dept. gw today

PHILCO CORPORATION

GOVERNMENT & INDUSTRIAL DIVISION PHILADELPHIA 44, PA.

Wagner®
TRANSFORMERS
...the choice of leaders in industry

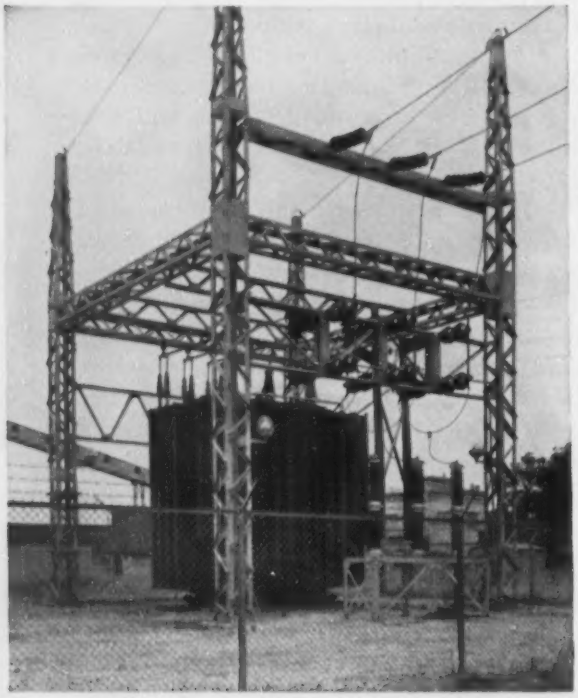
Kansas City, Kansas installs Wagner Transformer to assure across-the-city service

Kansas City's Board of Public Utilities has recently installed this 20,000/25,000 kva Wagner Power Transformer at the Municipal Plant, Quindaro Power Station, Kansas City, Kansas.

Quindaro steps up generator voltage from 13,800 to 67,000 volts for across the city service.

A Wagner Transformer was chosen for this installation, as Wagner Transformers are for many power systems and industrial plants, because of their ability to give adequate and reliable service over unusually long periods of time. Wagner Power Transformers have been serving the power industry dependably for over sixty years. Service records from the field, dating back to the Gay Nineties prove their ability to give extremely reliable service. They are compact in design and are built with great care to give them inherent strength and stability. They have sufficient capacity not only to carry their rated loads, but to be able to handle overloads whenever emergencies arise.

* * *

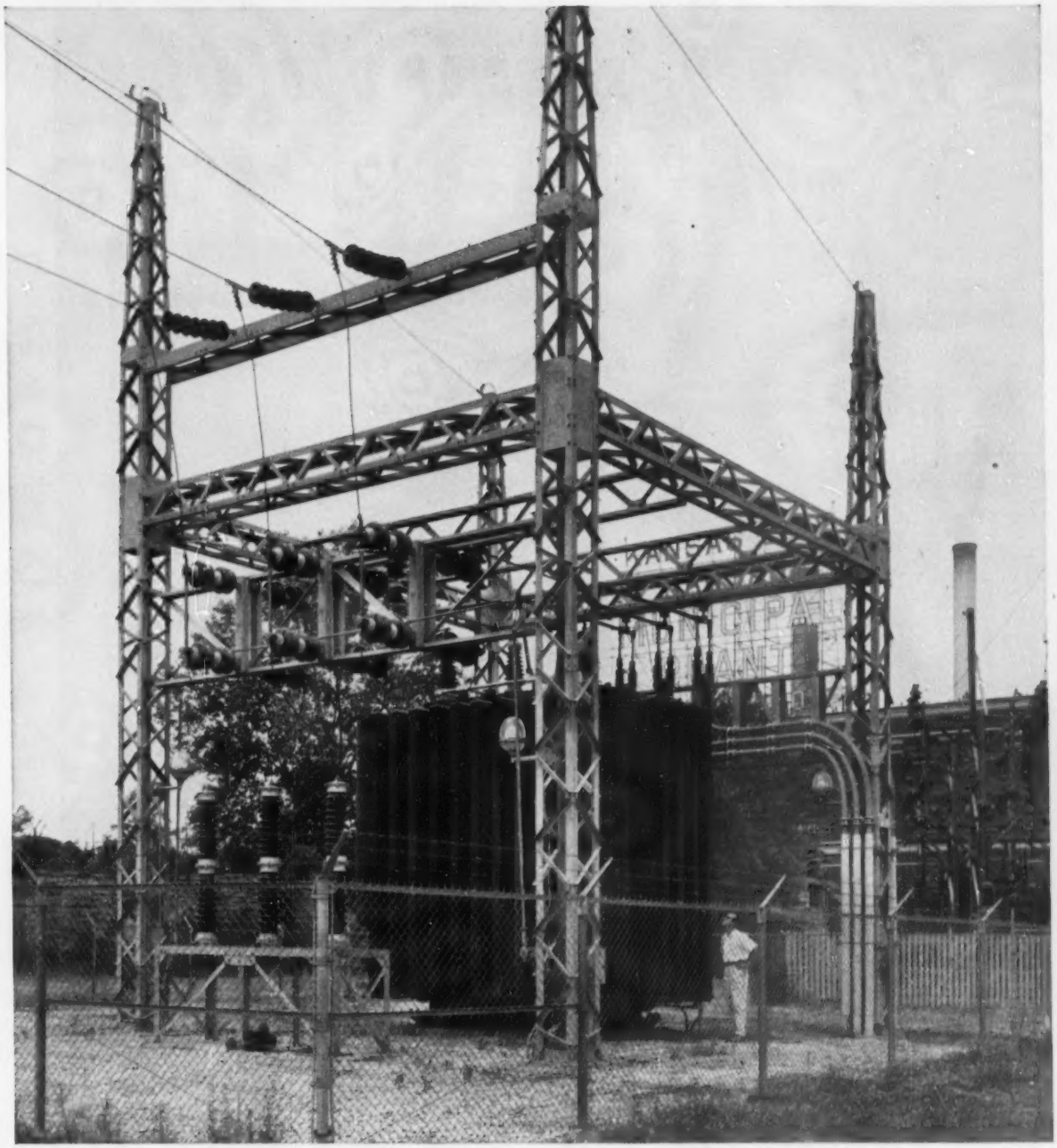


Wagner has all the manufacturing facilities and years of engineering "know-how" necessary to manufacture reliable power transformers. Why not consider Wagner Power Transformers for your next installation? 32 branch offices, located in principal cities, are maintained for quick, convenient engineering service and consultation.

If you need power transformers rated 10,000 kva and below—three phase, or 5,000 kva and below—single phase, why not check ASA C57.12a Standards and use them as your specifications? In addition to saving the cost of preparing specifications, you will also realize a substantial saving in price by using Wagner Standard Transformers.

Bulletins TU-180 and TU-181 give full information on Wagner Power and Distribution Transformers. Write for your copies today.

Wagner Electric Corporation
EST. WE 1891



20,000/25,000 kva Wagner Power Transformer at Kansas City, Kansas. Provisions have been made for blowers to be added when required to increase its rating to 33,333 kva.

WAGNER ELECTRIC CORPORATION

6456 PLYMOUTH AVENUE, ST. LOUIS 14, MO., U. S. A.

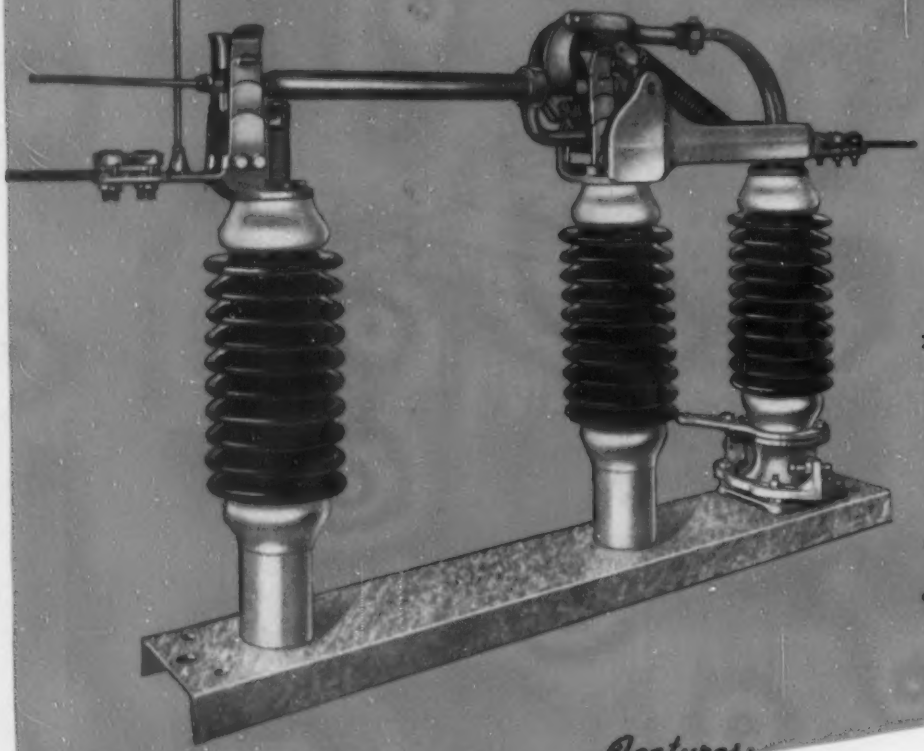
ELECTRIC MOTORS • TRANSFORMERS • INDUSTRIAL BRAKES
AUTOMOTIVE BRAKE SYSTEMS — AIR AND HYDRAULIC

BRANCHES IN 32 PRINCIPAL CITIES

T54-6

Get easy "summer operation" with KEARNEY

Group Operated



VERTICAL BREAK

7,500 to 69,000 volts

400 Amps., 7.5 KV to 34.5 KV

600 Amps., 7.5 KV to 69 KV

1200 Amps., 7.5 KV to 69 KV

Only 3 moving parts. Simple, rugged, and completely adjustable for right or left-hand installation.

Features:

Positive current transfer from blade to line terminals through high pressure contacts.

Rugged tubular blade of electrolytic hard drawn copper, balanced and aligned.

Easy adjustment for phase synchronization.

No flexible shunts.

Oilite bearings for easy operation.

Both ends of blade seat in silver overlay contacts. No current transfer through hinge bearings on the Rotating Switch.

Weather-sealed blade adjustments on Side Break Switch.

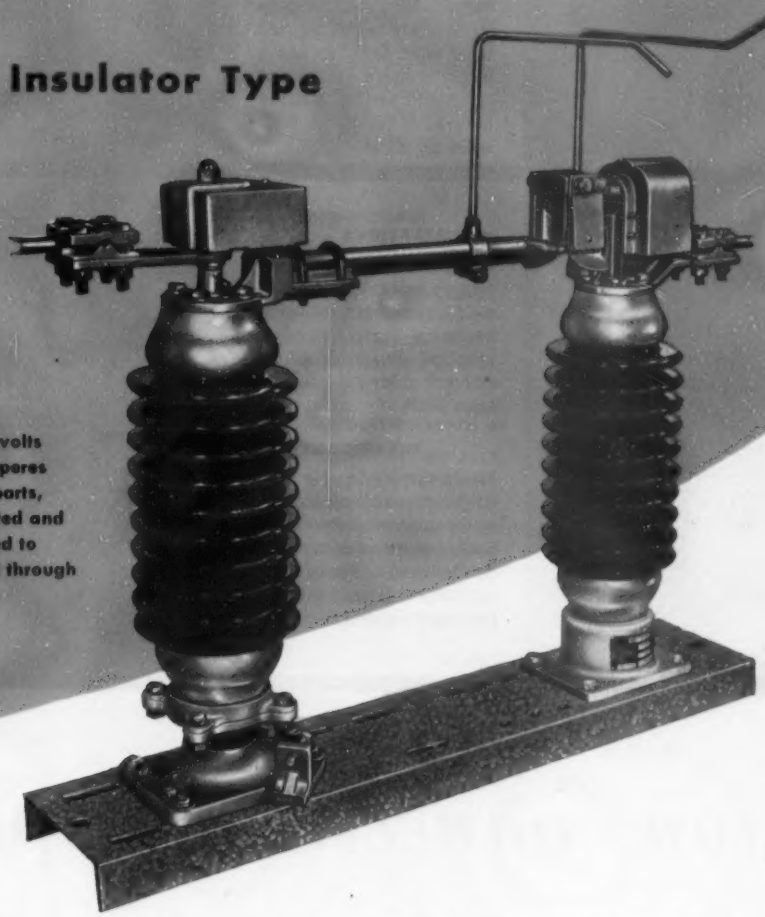
Ice-breaking, rotating jaw contact controlled by blade movements on Side Break Switch. No springs or cams.

ENGINEERED TO OPERATE UNDER THE TOUGHEST ICING CONDITIONS

Specify **KEARNEY**

all winter long
Disconnect Switches

Rotating Insulator Type



SIDE BREAK

7,500 to 69,000 volts
400 and 600 amperes
Only 2 moving parts, heavily constructed and bearing supported to insure alignment through years of service.

When you need them most they're on the job! These trouble-proof switches are ready to operate regardless of weather.

Smooth operating, cool-running and corrosion-resistant, Kearney Rotating Insulator Switches bring you the utmost in modern disconnect switch performance.

Write today for complete information.

JAMES R. KEARNEY CORPORATION
4224-42 Clayton Avenue St. Louis 10, Mo.
Canadian Plant: Guelph, Ontario

FOR BETTER CONSTRUCTION • SAFER MAINTENANCE

Products

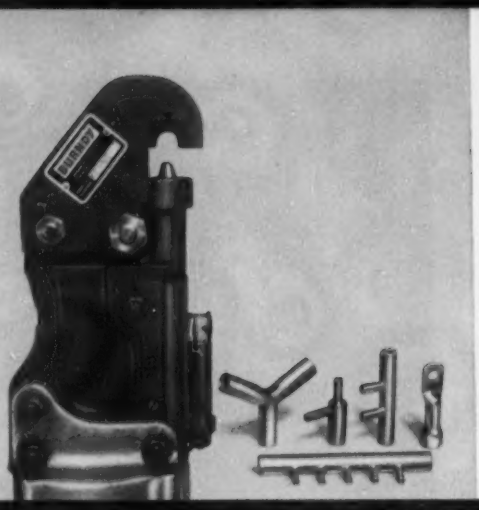
JAMES R. KEARNEY CORPORATION ST. LOUIS, MO. GUELPH, ONT.

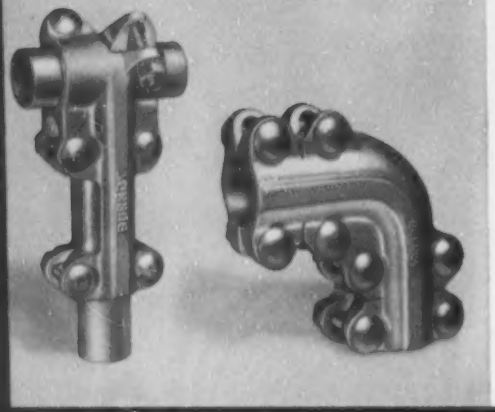
ELECTRICAL MANUFACTURING

Electrical and electronic equipment—from radio transmitters to motor controls, from home appliances to production machinery—utilizes Burndy-engineered connectors and high speed Burndy production tooling.

ORDNANCE, MARINE, AUTOMOTIVE

Specially developed Burndy connectors—Hylugs and Hysealugs (completely sealed against water, vapor, dust)—are now in rugged ordnance, marine, and automotive service. Matched installation tooling for high-speed production.





SUBSTATIONS

Burndy power connectors are ruggedly built to carry the high electrical currents, the heavy mechanical stresses of wind, icing, and other strain associated with utility and industrial power plants.

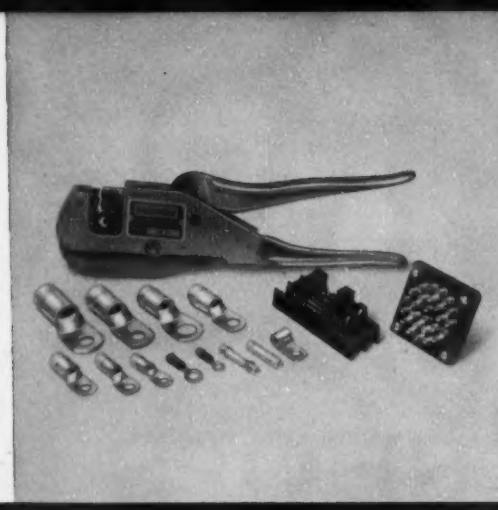
TRANSMISSION

Burndy Hysplices enable linemen to splice vital power lines, secure maximum electrical efficiency and mechanical strength. Burndy Hypress—"9 lb. tool with 9 ton bite"—insures speedy, economical installation.

a billion connections depend on

B U R

BURNDY — NORWALK, CONNECT. — TORONTO, CANADA

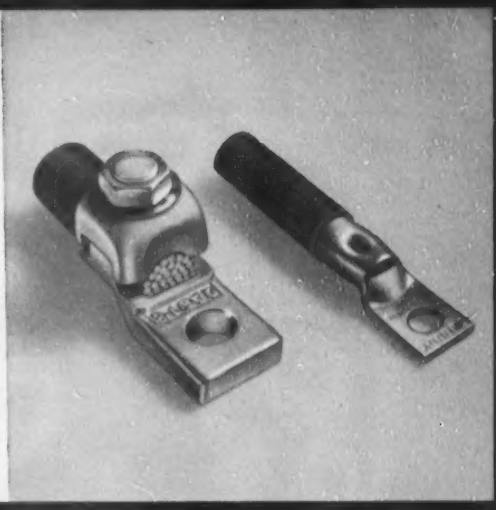


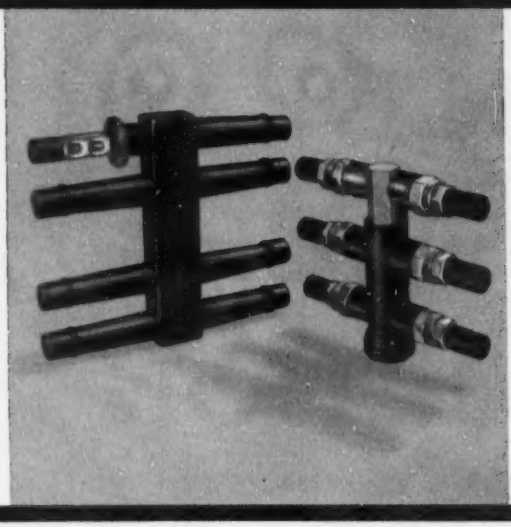
◀ **AIRCRAFT**

Modern jet aircraft as well as conventional high-altitude planes incorporate Burndy Hydent connectors, Pressurized Disconnect Panels, and Limiters as integral parts of their electrical systems.

BUILDING ▶

Engineers responsible for planning and maintaining electrical systems of homes, offices, industrial plants count on Burndy for trouble-free electrical connections. Burndy Qiklugs, Scrulugs, Hylugs...dependable names to remember.



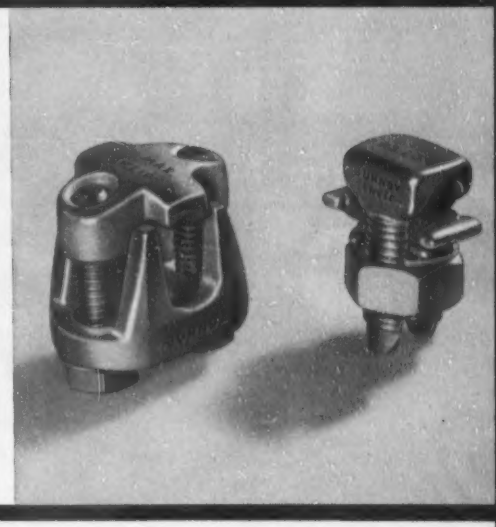


◀ **UNDERGROUND**

Burndy Moles and Molimiters provide maximum circuit protection, unlimited possibilities for underground system expansion. Burndy tools permit speedy, safe, economical installation in tight quarters.

DISTRIBUTION ▶

Service connections are made with a variety of Burndy connectors. The Burndy Servit and Oklip are the most widely used and re-used connectors in America. Burndy compression connectors—and matched tooling—are coming into increasingly wide use.

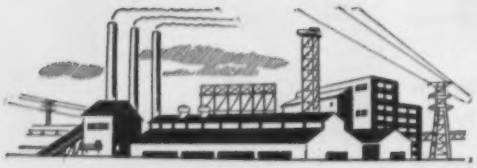


N D Y

In the production, transmission, consumption of power...wherever current flows... you'll find Burndy connectors on the job—joining, terminating, clamping or protecting the circuits which enable electricity to do the work of man. The Burndy line is the *engineered* line, with specialized connectors for every industry using electrical current—and that means *every* industry in America.

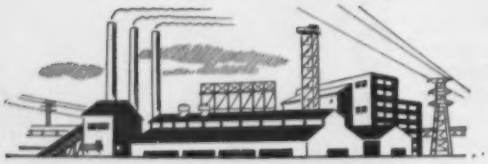
If your job involves connectors—write Burndy for technical counsel for complete, professional catalogs covering your specific field.

FACTORIES: NEW YORK, CALIFORNIA, TORONTO • **EXPORT:** PHILIPS EXPORT COMPANY 53-27

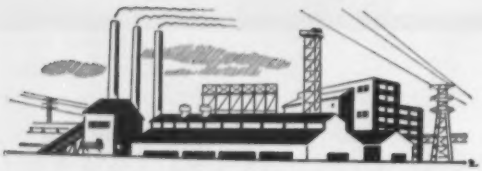


Seattle

3 SHOPS FOR TOWER FABRICATION



South San Francisco



Leetsdale

To meet your transmission-tower requirements, Bethlehem offers the services of three large tower-fabricating shops, at Seattle, Wash., South San Francisco, Calif., and Leetsdale, Pa. Each shop has complete fabricating facilities, and can handle quantity production of any type of tower you may have in mind.

What's more, our engineering staff has had years of experience in designing both single- and double-circuit towers for practically every load condition.

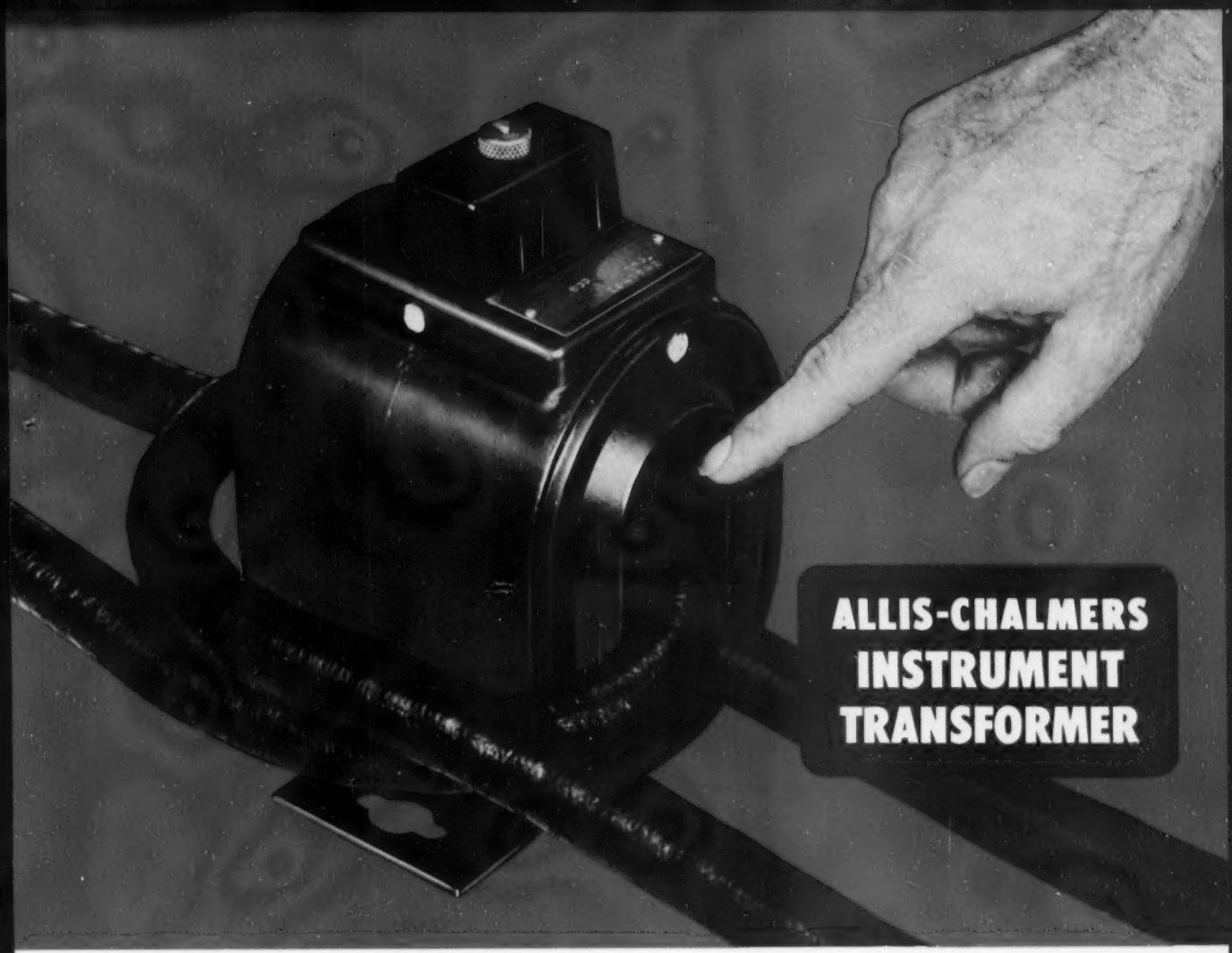
Perhaps you would like to talk over your tower requirements with a Bethlehem man. Just drop a line to the nearest Bethlehem office.

BETHLEHEM STEEL

Bethlehem Steel Company, Bethlehem, Pa.

On the Pacific Coast the fabrication of transmission towers is handled by Bethlehem Pacific Coast Steel Corporation
Export Distributor: Bethlehem Steel Export Corporation

Transmission Towers



Thru-Type Transformer with Oval Window Holds More Conductors

There is more room for conductors in the new type TWM Allis-Chalmers 600 volt indoor-outdoor current transformer than in any other thru-type current transformer of corresponding rating now on the market. The oval window (dimensions: 1⅜ by 2¾ inches) is large enough to hold two 500 MCM stranded conductors with 600 volt insulation. Yet the Type TWM A-C current transformer is lightweight and compact. It is small enough for multiple mounting in standard instrument transformer enclosures. It is molded in thermo-setting resin.

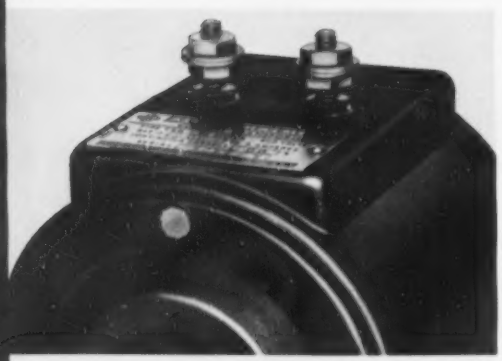
Installation is simple. You can mount them in any position — they have special provision for different mounting needs. Connections can be made faster than on previous current transformer designs. It is possible to obtain a number of different ratings from a single unit.

A-4220

Detailed Information Inside

ALLIS-CHALMERS

Connection Time Reduced By Thru-Type Design

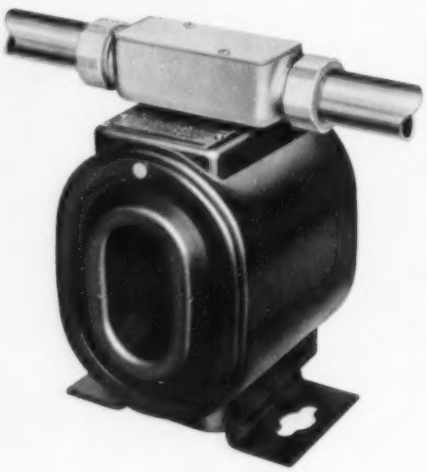


Installation time of through-type transformers is greatly reduced because bolted primary connections are eliminated with the thru-type design. Elimination of bolted connections also simplifies future change-over caused by load growth.

For permanent identification, primary and secondary polarity markings are molded directly into the resin. An etched stainless steel nameplate on top of the unit contains all essential information for correct operation.

Left: Secondary terminals are located at top of transformer. This permits mounting transformers close together when necessary. Terminals are non-corrodible studs with ¼-28 thread. A weather-resistant sealable cover (shown in lower photograph) protects terminals and may be turned to permit making connections from either side.

Right: If desired, a standard conduit box can be substituted for the molded terminal block and cover. It is only necessary to drill two holes in the conduit box and install with insulating washers. All connections can be made quickly.

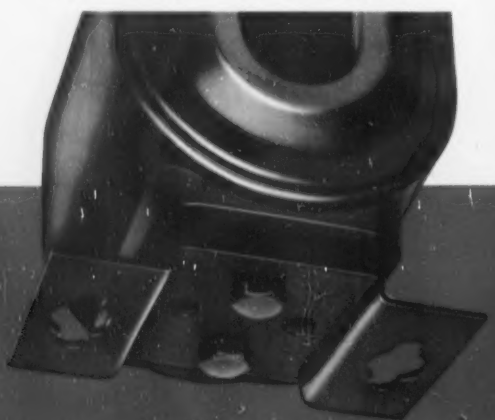


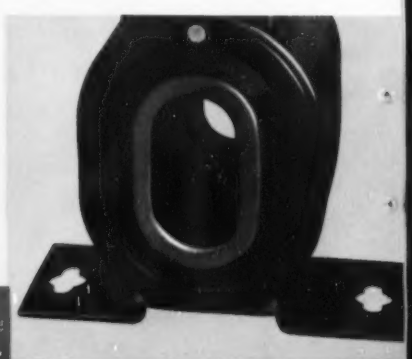
Mount It in Any Position

Type TWM current transformer can be mounted in any position — vertically, horizontally, or inverted. No hangers or enclosing boxes are required.

The base is a formed steel plate bolted with cap screws onto inserts anchored in the assembly. It can be rotated 90 degrees by using an alternate set of bolt holes. Picture at lower left shows base in conventional position; at center below shows base rotated.

The standard base has 4¼ inch mounting centers. An optional base is available with 6¼ inch mounting centers (shown below, right). No charge is made for optional base if specified when ordering.





ALLIS-

Maintenance Eliminated!

Allis-Chalmers new type TWM thru-type current transformer is molded in thermo-setting resin. It requires no painting. It has an inherent toughness that promotes long life and resistance to all kinds of weather. The molded resin serves as insulation, support, and casing for the transformer.

Only the secondary terminal inserts and the base mounting inserts protrude from the molded body. A perfect seal is established because of the excellent adhering qualities of the material used in the molding process.

TRANSFORMER ACCURACY

The Type TWM current transformer is designed for high accuracy with a burden of one or more watthour meters. The ASA accuracy classification is shown in the chart at left.

Amperes	Burden	
	B-0.1	B-0.2
	Accuracy	Class
200	0.3	0.6
400, 600, 800	0.3	0.3

Thermal Ratings: The 200, 400, and 600 ampere transformers can be operated continuously at 200% of rated current. The 800 ampere transformer can be operated continuously at 150% of rated current.

Ratings Available: Type TWM current transformer is manufactured in four primary current ratings. They are 200, 400, 600, and 800 amperes. However, intermediate ratings may be obtained by passing the primary conductor through the window two or more times.

When the unit is used as a three-wire transformer, the two outside conductors are passed through the window, with one conductor being looped through the window in the reverse direction. The chart below shows ratings for two- and three-wire service.

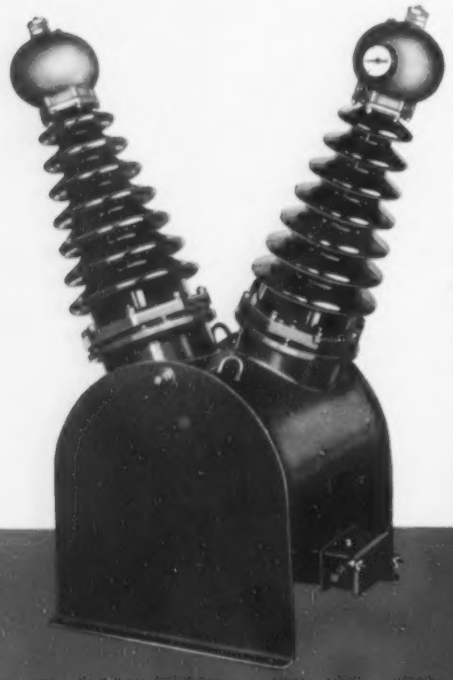
Ratings							
Two-Wire Service				Three-Wire Service			
One Turn of Primary Conductor		Two Turns of Primary Conductor		One Turn of Each Primary Conductor		Two Turns of Each Primary Conductor	
Amperes	Ratio	Amperes	Ratio	Amperes	Ratio	Amperes	Ratio
200 to 5	40:1	100 to 5	20:1	100/100 to 5	20:1	50/ 50 to 5	10:1
400 to 5	80:1	200 to 5	40:1	200/200 to 5	40:1	100/100 to 5	20:1
600 to 5	120:1	300 to 5	60:1	300/300 to 5	60:1	150/150 to 5	30:1
800 to 5	160:1	400 to 5	80:1	400/400 to 5	80:1	200/200 to 5	40:1
Transformer Weight (All ratings) NET . . . 14 lbs. SHIPPING . . . 16 lbs.							

CHALMERS

A-C ALLIS-CHALMERS

Compact, Lightweight Transformers Save Space, Speed Installation

Less floor space is needed with Allis-Chalmers complete line of oil-insulated outdoor current and potential transformers for circuits 69 kv and below. In addition, their advanced design cuts weights up to 40%, resulting in units that are easier to handle than older designs. You get greater insulation strength and higher thermal ratings than could be provided previously.



CORONA-FREE DESIGN

Corona is kept from developing — another step toward extending transformer life. Tanks are all-welded and hermetically sealed to protect insulation and oil from sludge formation. The unique bushing construction permits circulation of oil through bushing and transformer, saving on oil requirements and reducing transformer sizes.

Continuous long-time overvoltage tests for extended periods of time were made on transformers of all voltage classes. The units successfully withstood standard applied potential and impulse tests. Further tests, with the units purposely contaminated to give a resultant power factor many times higher than normal, successfully withstood the standard applied potential and impulse tests.

***Get all the facts** on these lightweight, modern transformers. Contact your nearby Allis-Chalmers district office or write Allis-Chalmers, Milwaukee 1, Wisconsin, for more information.*

ALLIS-CHALMERS

INSTRUMENT TRANSFORMER

POTENTIAL

Rating	Floor Space	Height	Weight
SPW-2 24 kv	14½ x 14⅝	36½	252
SPW-3 34.5 kv	15½ x 16⅝	39	310
SPW-4 46 kv	19 x 19	49	615
SPW-6 69 kv	25½ x 24	61	1050

CURRENT

Rating	Floor Space	Height	Weight
SCW 25 kv	14" x 19"	42"	340
SCW 34.5 kv	14" x 19"	45"	355
SCW 46 kv	16" x 23"	55"	500
SCW 69 kv	16" x 23"	61"	565

ALLIS-CHALMERS

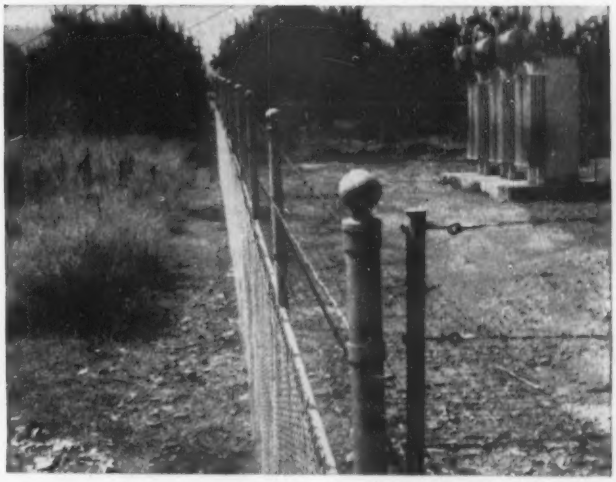
A-C ALLIS-CHALMERS

Milwaukee 1, Wisconsin

Have you compared costs of weed control lately?

It's economical
because it's simple
and long-lasting
when you use

Du Pont "Telvar" W
Weed Killer



An application of "Telvar" W Weed Killer every year or two cuts maintenance costs around power stations like this. Weeds on the left show type of vegetation involved.

One spraying of as little as 40 to 60 pounds of Du Pont "Telvar" W per acre can get rid of vegetation *for a growing season or longer!* This powerful weed killer kills through the roots . . . remains in the ground to prevent new growth. Its lasting chemical action is just what's needed around power plants, substations, pole yards, storage yards, fencerows, etc.

Savings for You

With "Telvar" W on the job, you'll save labor and maintenance costs. A single spraying takes the place of laborious cutting and mowing . . . expensive multiple spraying. You eliminate the problem of storing and handling bulky weed killers, too. It all adds up to new efficiency in weed control—new economy in keeping key areas neat and trim.

Easy and Safe to Use

"Telvar" W is a wettable powder that mixes readily with water and is low in toxicity to humans and animals. Non-volatile, non-flammable and non-corrosive, it can easily be applied by standard spraying equipment.

Your Custom Sprayer Can Help

Specify "Telvar" W for this year's weed-control program. If you don't have spraying equipment, get in touch with a reliable custom sprayer to do your weed killing on an annual basis.

For more information about Du Pont "Telvar" W, clip and mail the coupon to E. I. du Pont de Nemours & Co. (Inc.), Grasselli Chemicals Department, Wilmington 98, Delaware.

Mail This Coupon
for Free Booklet

E. I. du Pont de Nemours & Co. (Inc.)
Grasselli Chemicals Department, Rm. D-4026
Wilmington 98, Delaware

☐ Please send me your booklet describing positive weed control with "Telvar" W. ☐ Send me the name of my nearest supplier.

Name_____ Position_____

Firm_____

Address_____

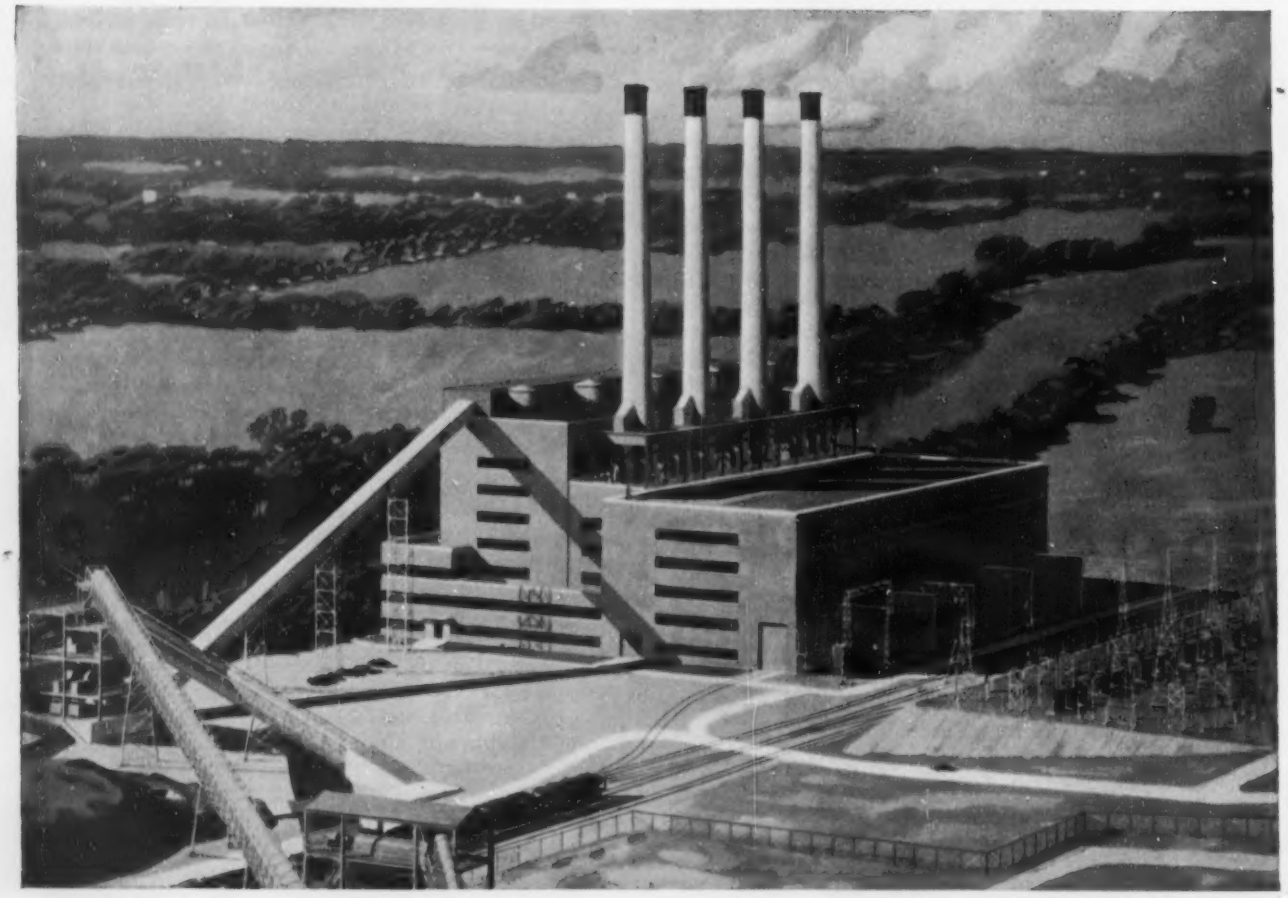
City_____ State_____

DU PONT TELVAR W
REG. U.S. PAT. OFF. TRADE-MARK
Weed Killer

BETTER THINGS FOR BETTER LIVING . . . THROUGH CHEMISTRY

On all chemicals always follow directions for application. Where warning or caution statements on use of the product are given, read them carefully.

New Wabash River Station of Public Will Boost System's



NEW WABASH RIVER STATION, West Terre Haute, Ind., of the Public Service Company of Indiana, Inc., designed by Sargent & Lundy, Inc., consulting engineers, will have four Foster Wheeler reheat-type steam generators with the following capacity:

Maximum continuous capacity

Primary steam flow.....700,000 lb per hr
Reheat steam flow.....624,000 lb per hr

Operating pressure

Superheater outlet .....1500 psig
Reheater outlet ..... 401 psig

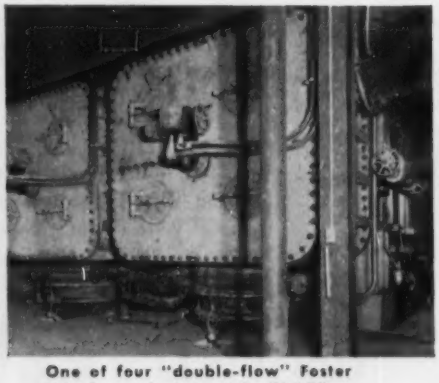
Final steam temperature.....1005 F

Final reheat temperature.....1005 F

Feed water temperature..... 451 F

Coal pulverized by Foster Wheeler ball mills, two for each steam generator.

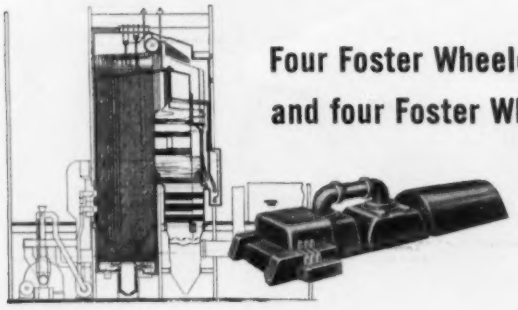
Foster Wheeler vertical circulating pumps, two of which provide a total of 62,000 gallons per minute of cooling water to each condenser.



One of four "double-flow" Foster Wheeler condensers, of the 70,000 sq ft rectangular, two-pass design.

Service Company of Indiana, Inc.
Output Capability to 940,000 kw

...*with four reheat cycle steam generators!*



Four Foster Wheeler 700,000 lb/hr reheat steam generators and four Foster Wheeler 70,000 sq ft "double-flow" condensers will serve turbines each with a gross generator output of 100,000 kw.

Designed to operate on the reheat cycle, the four Foster Wheeler steam generators at the new Wabash River Station of the Public Service Company of Indiana, Inc. will have an aggregate capacity of 2,800,000 lb steam per hr.

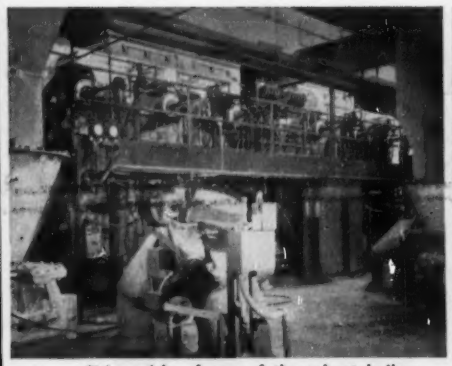
The use of combination radiant and convection superheaters makes possible precision control of final steam temperature over a wide load range. Since superheating is done partly in the radiant section, the gas temperature leaving the furnace can be sufficiently reduced so that, even with the Indiana coal used, complete freedom from furnace slagging is assured.

An all-convection reheater is located deep in the low-gas-temperature zone beyond the convection superheater section. Here safe metal temperatures are maintained during starting, shutting down and under emergency operating conditions. Reheater final steam temperature is controlled by regulation of by-pass dampers located at the economizer outlet.

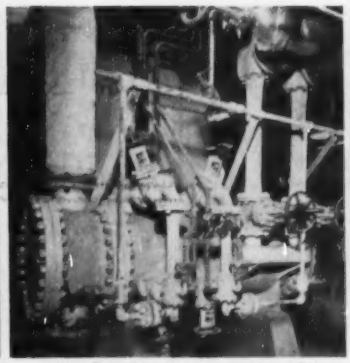
Outstanding features of the "double flow" type condenser are its inherent deaerating action and its complete utilization of available headroom. Also incorporated is a special provision for reversing the circulating water flow, thereby providing a desired cleaning action of condenser tubes.

FOSTER WHEELER CORPORATION, 165 Broadway, New York 6, N. Y.

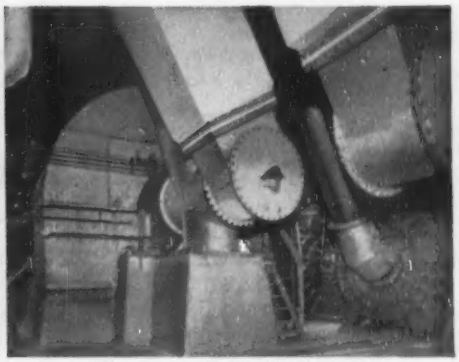
FOSTER WHEELER



Firing aisle of one of the reheat boilers shortly after initial start-up.



Twin-element two-stage steam-jet air-ejector, with combined surface inter- and after-condensers, maintains vacuum in each 70,000 sq ft condenser.



Exhausters and ball mill pulverizers located on basement level.

Like an evil eye, fire is constantly on the lookout for unprotected hazards such as flammable liquids, electrical equipment, materials in process. Get protection that never sleeps. Guard every hazard in your plant with a Kidde Automatic Fire Extinguishing System.

Quick as a wink, check the 'yellow pages' for your local Kidde dealer.

The words 'Kidde', 'Fyre-Freez' and the Kidde seal are trademarks of Walter Kidde & Company, Inc.

Kidde

Walter Kidde & Company, Inc.
330 Main St., Belleville 9, N.J.
Walter Kidde & Company of Canada, Ltd., Montreal—Toronto

"Neglect commercial cooking load today, and you can lose $1,000,000 in extra revenue tomorrow."

"In 1952, and again in 1953, our company—Appalachian Electric Power Company—added approximately 14,000 KW of new commercial cooking load to our lines in Virginia and West Virginia.

"This represents business that we would not have gotten without a full-scale commercial cooking promotion program. As a matter of fact, this business might have been lost to us for years without aggressive action on our part. Because of its very desirable characteristics, competition is keen for the commercial cooking load, and only 'hard selling' has made possible the capture of a substantial part of this market for our service.

"Our discovery of the importance of the commercial cooking market is not new. In certain other utilities, such as Union Electric, Pennsylvania Power & Light and West Penn, this business is already near or above the million dollar mark.

"Promotion of commercial cooking presents a unique opportunity. Though the business is highly competitive, because of the inherent advantages of electric cooking it can be successfully promoted to bring a substantial return for a relatively small investment. Not only does the commercial cooking load represent good business for the utility, but it presents very large benefits to the giant food-service industry.

"This business opportunity can best be realized through planned, year-around commercial cooking sales activity."

—Julius Hall, Jr., *Commercial Manager*, Appalachian Electric Power Company

Here's the 8-POINT SUCCESS FORMULA used and recommended by utilities that have made a big business of Commercial Cooking:

1. Top management's enthusiastic support, interest and cooperation.
2. Trained, incentivized supervisors backed by sufficient field specialist man-hours.
3. A financial investment in proportion to the market's profit potential.
4. A *year-around* commercial cooking program. (Facts prove part-time programs wasteful, as sales from a once-a-year "push" never offset the hundreds lost to competition during inactive months.)
5. A *3-month* "maximum effort" special campaign on commercial cooking.
6. Special promotion activity, using Hotpoint's successful programs for operator group meetings, plus free-trial installations, etc.
7. Complete kitchen layout service.
8. 24-hour service, plus availability of "loaner" equipment to prevent temporary shutdowns.

★ ★ ★

Want to share our commercial cooking facilities and programs? Write, and I will give your letter my personal attention.

Orrin E. Wolf

Orrin E. Wolf, Vice President, Hotpoint Co.

Hotpoint ALL ELECTRIC **Commercial Cooking Equipment**

Hotpoint Co. A division of General Electric Company

Commercial Equipment Department, 265 South Seeley Avenue, Chicago 12, Illinois

let's lay it

on the line !

In almost every instance, aluminum conductor offers savings over copper. By one standard, the ASTM specs, aluminum conductors may look the same. By other standards, the electric light and power industry's own, Alcoa® Aluminum Conductor is a standout.

Here are the plus factors you get when you buy Alcoa Aluminum Conductor, and without paying a penny more!

1. Every run tested throughout every production phase for metallurgical, mechanical and electrical uniformity.

2. Consistently uniform manufacture and tight stranding.

3. Cable for every service requirement including designs for special applications.

4. The services of the largest and best qualified headquarters and field engineering staff in the industry.

5. The latest developments and newest applications backed by Alcoa's unequaled 55 years of experience and leadership.

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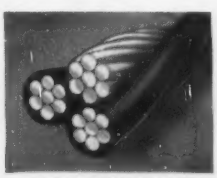
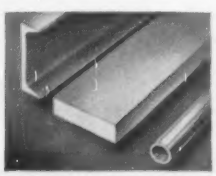
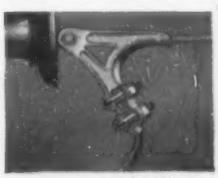
ALCOA ALUMINUM

ALUMINUM COMPANY OF AMERICA

ACSR and All-aluminum Wire and Cable


Covered Wire and Service Drop


Bus Conductors of All Types


Accessories for All Conductors

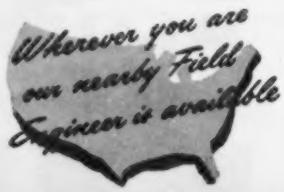
when industrial turbo-generators go bad National gets them back to work **FAST**

When unexpected turbo-generator failure cripples your operations, call National. Your generator will be back on the job in a hurry. Delivery of the rewound unit, or of the necessary rewinding materials, can be made with startling speed because all of the wire and insulating materials used in your windings are fabricated right in the National plant.

National facilities for servicing industrial turbo-generators include large lathes, balancing machines and other tools for mechanical repairs as well as complete equipment for the production of rotor and stator windings. But the big plus value in National service is "know-how". Skilled workmen who know that careful coil installation can make a big difference in the service life of your generator. Engineers who know how to spot and correct the little defects which can bring you big savings in maintenance costs.

National stands for fast service. Yes, but not at the expense of quality. Frequently, in fact, National engineers are able to introduce modifications of design or materials that will make your generator better than ever. "As good as new" is not good enough for National. That's why National rewinding pays for itself so quickly.

No matter what kind of rotating electrical equipment you operate — if it's giving you trouble, call National.



NATIONAL ELECTRIC COIL COMPANY

COLUMBUS 16, OHIO, U. S. A.

ELECTRICAL ENGINEERS: MAKERS OF ELECTRICAL COILS AND INSULATION
REDESIGNING AND REPAIRING OF ROTATING ELECTRICAL MACHINES

NOT A SINGLE LUMP IN ALL SIX THROATS

Nothing impedes the efficient air flow through the fan throats of Pritchard cooling towers.

The neat design of the modified Venturi throat, the precision-manufactured assemblies and the rigid, bolted construction all contribute to smoother air flow and permit the closest possible blade clearances. Such exactness results in exceptional fan efficiency.

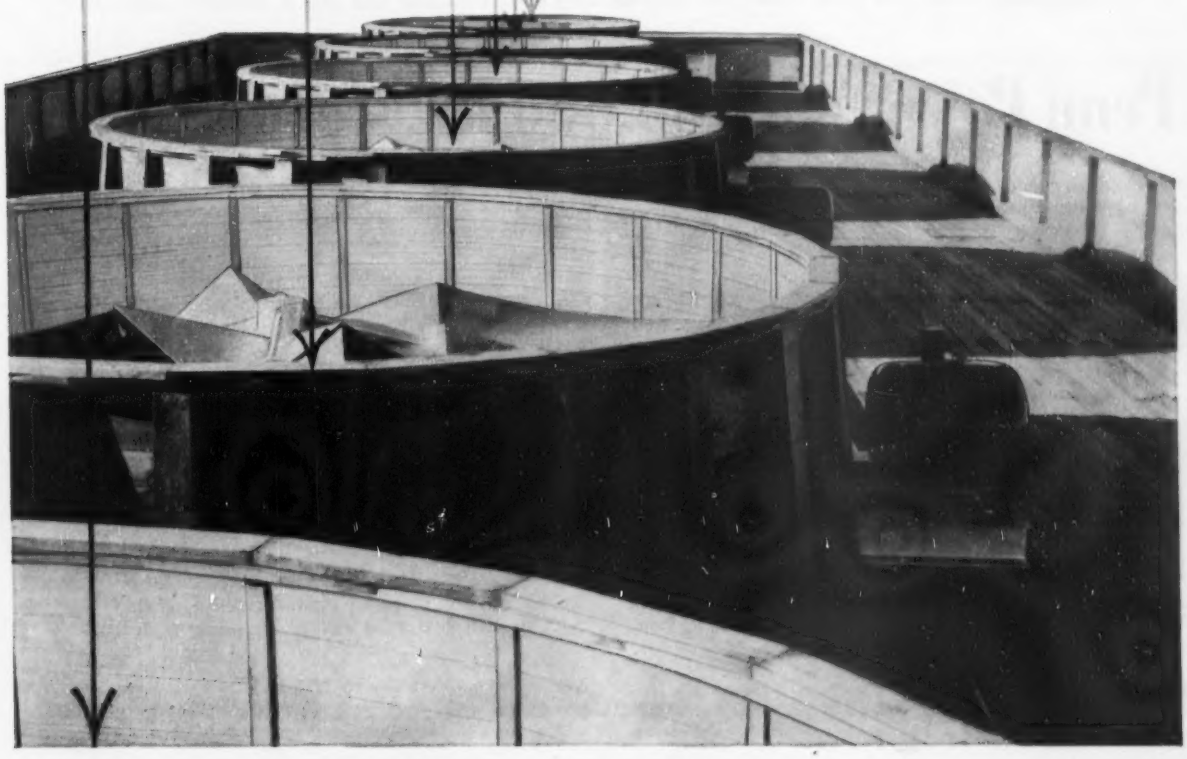
You want outstanding cooling performance. You want to increase the efficiency of your power plant. Then find out all the reasons why Pritchard Heavy-Duty Cooling Towers do these jobs better. Contact your Pritchard representative listed in the classified section of the telephone directory or write direct to the address at right.

Industry's Partner for Progress

J. F. Pritchard Co.
OF CALIFORNIA
A DIVISION OF J. F. PRITCHARD & CO.
Dept. 363, 210 West 10th St., Kansas City 5, Mo.

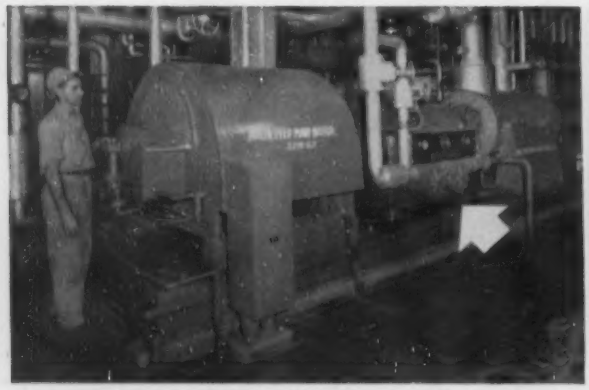
COOLING TOWERS
SPECIALIZED HEAT EXCHANGERS
GAS & AIR TREATING EQUIPMENT

Representatives in Principal Cities from Coast to Coast

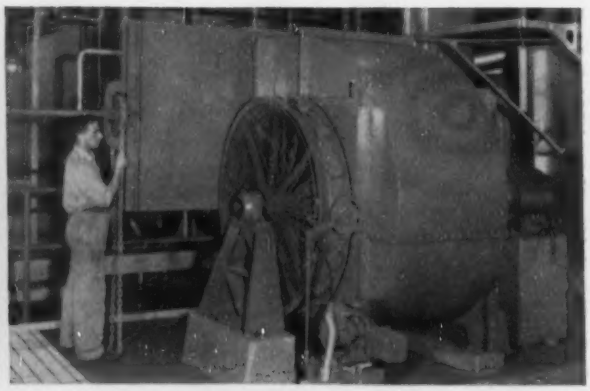


Pennsylvania Power's New Castle Power Plant serves the needs of a 1400 square mile area in western Pennsylvania.

Penn Power adds 85,000 kw. steam-electric

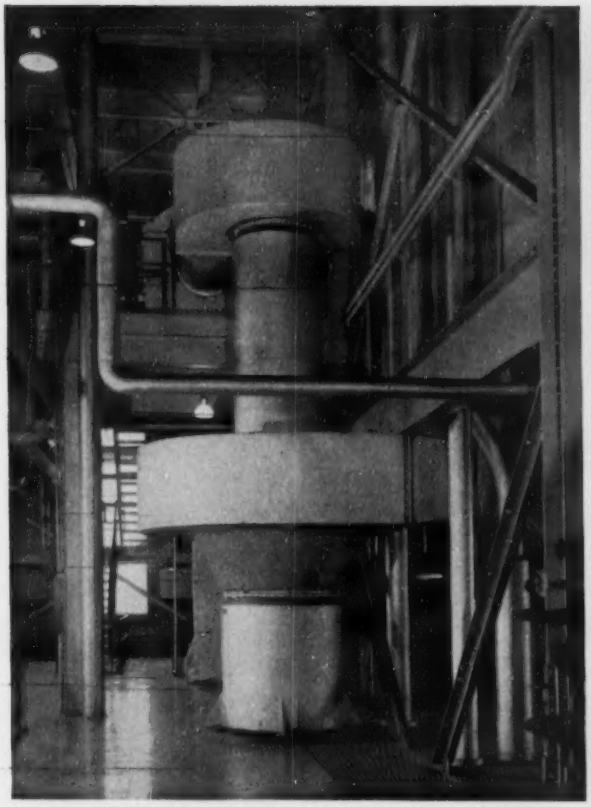


An American Blower Gyrol Fluid Drive (arrow) controls the Boiler Feed Pump at Pennsylvania Power's New Castle Plant.

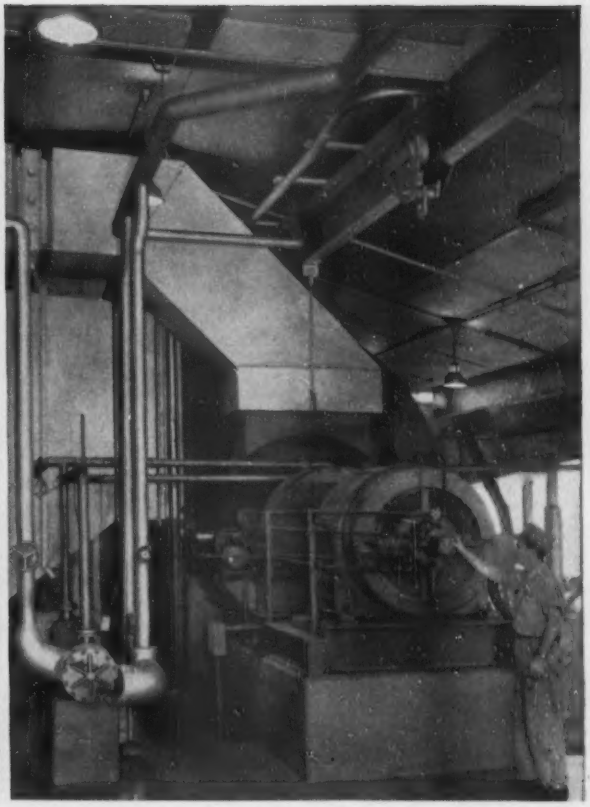


Shown above is an American Blower Tempering Air Fan for use with the new generating unit. It is a single width fan.

Serving home and industry: AMERICAN-STANDARD • AMERICAN BLOWER • CHURCH SEATS & WALL TILE • DETROIT CONTROLS

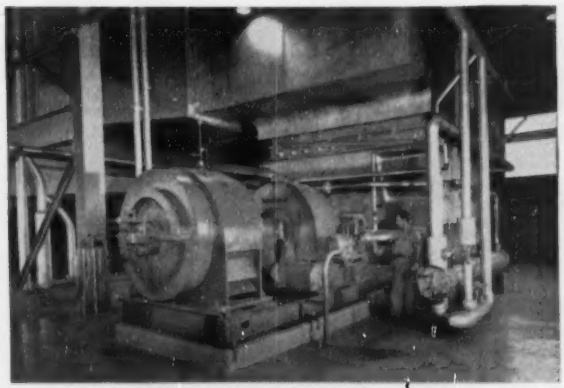


American Blower Fly Ash Precipitator and Secondary Dust Collectors are installed in the New Castle Plant's new generating unit. Primary collectors have capacities of 315,000 cfm at 275° F. and 2.2" SP wg, 210,000 cfm at 275° F. and 1.07" SP wg, and 105,000 cfm at 275° F. and 0.32" SP wg.



Shown is double width, double inlet American Blower Forced Draft Fan being driven through an American Blower Gyrol Fluid Drive. Its capacity is 230,000 cfm of 100° F. air at 12" wg static pressure. American Blower engineers will help you plan mechanical draft equipment for your exact needs.

generating unit



Sirocco Induced Draft Fan with Gyrol Fluid Drive has capacity of 350,000 cfm of 275° F. gas at 15" wg static pressure.

Like other investor-owned electric utilities, Pennsylvania Power Company is constantly planning ahead to meet future electricity needs.

The latest expansion — an 85,000 kilowatt turbo-generator for the New Castle Power Plant — is the largest in the company's history. Not counting transmission facilities, the new addition represents an investment of $12,771,000.

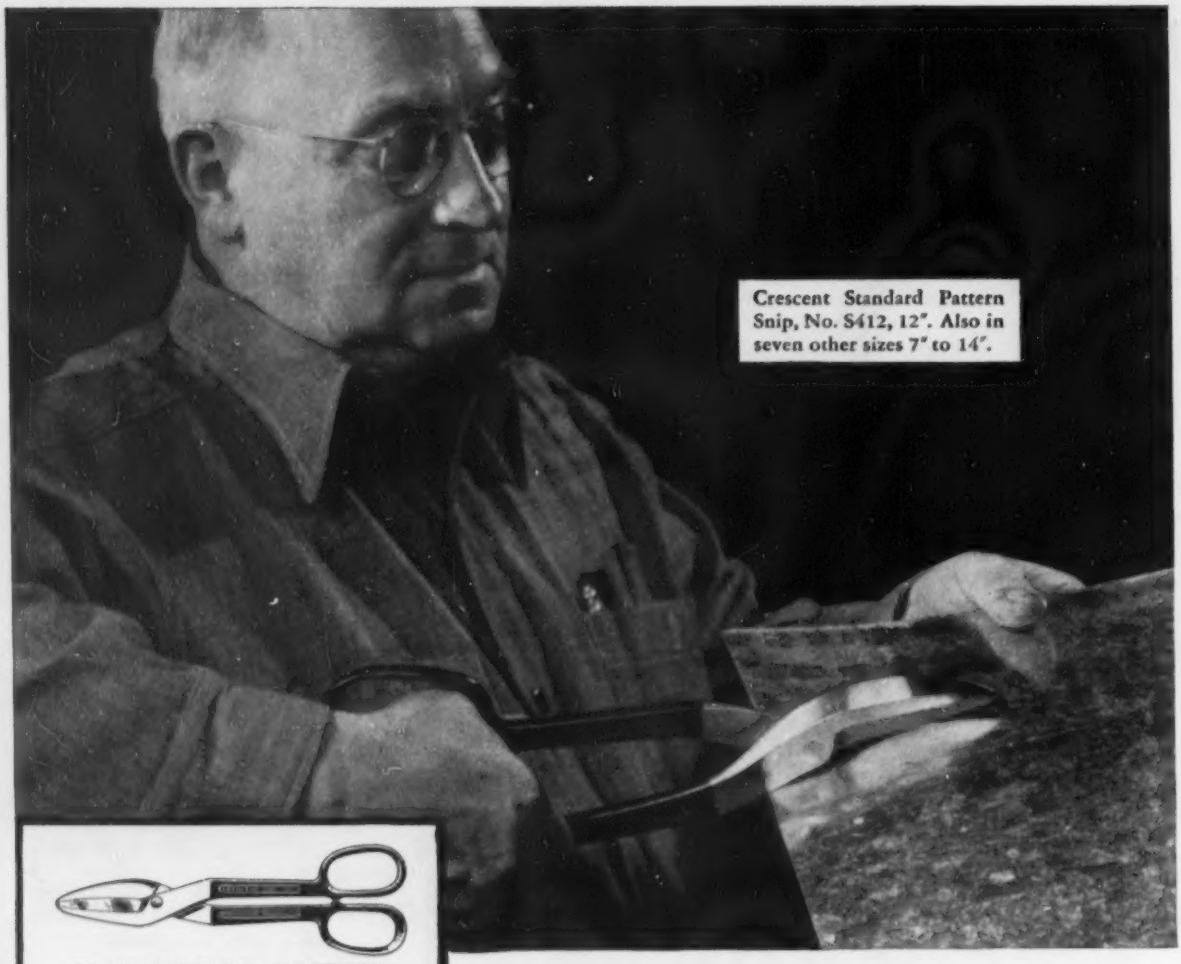
American Blower products — Mechanical Draft Fans, Dust Collecting Equipment and Gyrol Fluid Drives — are used in the new Pennsylvania Power generating unit because of their proven dependability and long-term economy.

American Blower engineers will be pleased to co-operate in *your* expansion program. Consult the nearest American Blower Branch Office or write us direct.

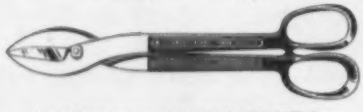
AMERICAN BLOWER CORPORATION, DETROIT 32, MICHIGAN
CANADIAN SIROCCO COMPANY, LTD., WINDSOR, CANADA
Division of American Radiator & Standard Sanitary Corporation

KEWANEE BOILERS • ROSS EXCHANGERS • SUNBEAM AIR CONDITIONERS

AMERICAN BLOWER



COMBINATION PATTERN
U412, 12" only.



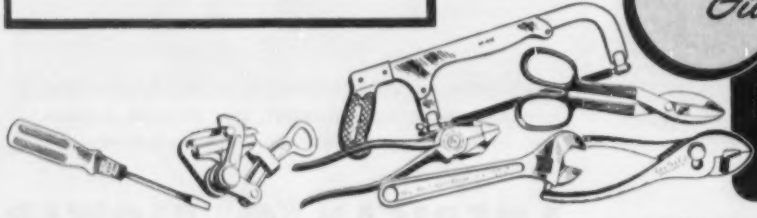
HEAVY DUTY SNIPS
U416, 16" only.

CIRCULAR CUTTING SNIPS
T412, 12". Also in 7" size.

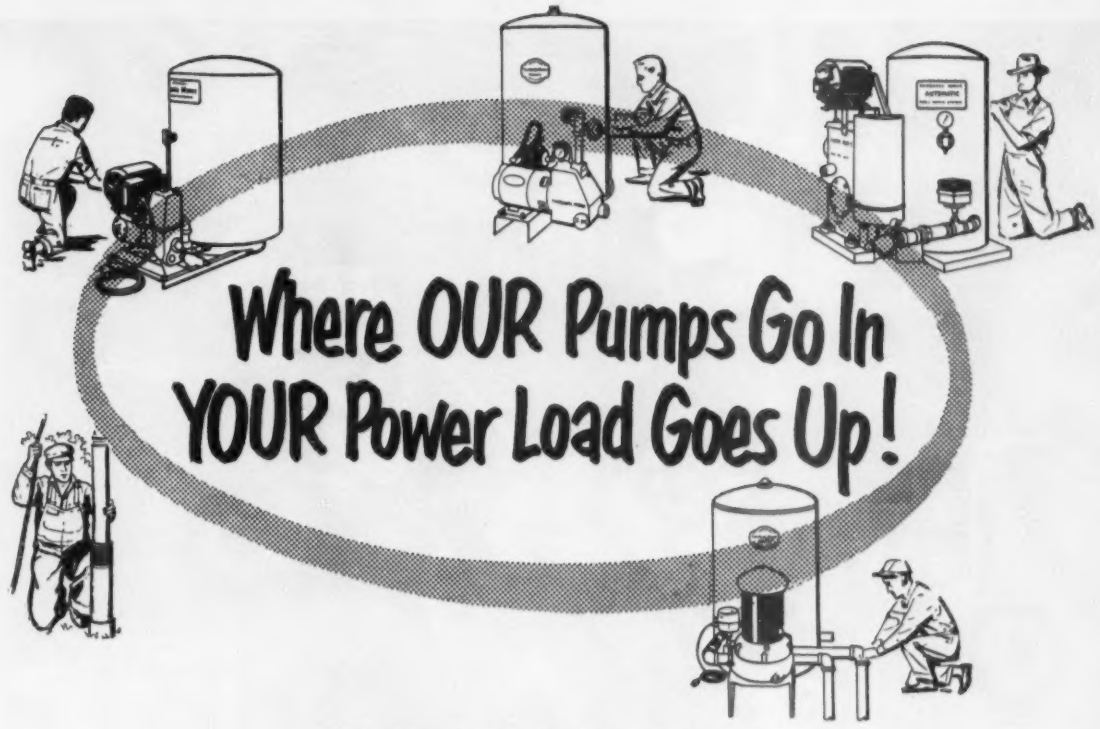
CRESCENT SNIPS

All Crescent Snips are forged of selected steel and blades ground on special grinding machines. They are hardened by Crescent's own selective induction process to insure long, satisfactory service. These easy-cutting, well-balanced snips are made in four patterns; standard, circular cutting, combination and heavy duty. *Sold by Industrial Distributors and Hardware Dealers everywhere.*

CRESCENT TOOLS
Give Wings to Work
®
Sign of the Artisan
Symbol of Excellence



Crescent is our trade-mark, registered in the United States and abroad, for wrenches and other tools. Sold by leading distributors and retailers everywhere and made only by
CRESCENT TOOL COMPANY, JAMESTOWN, NEW YORK



Where OUR Pumps Go In YOUR Power Load Goes Up!

Usually the first home utility bought by a new high line customer is an electric water system.

With this basic utility installed in the home, a woman becomes the world's best prospect for many other load-building appliances—a water heater, washer dryer, ironer; garbage disposal unit, an electrically-controlled heating system, and an automatic dish washer.

Her husband also buys load-building appliances. Often he installs a water heater in the milk house before his wife enjoys one in her home. He buys electrically operated water tank heaters and automatic waterers. And he may even install a *second* electric pump for farm operations only!

FAIRBANKS-MORSE

a name worth remembering when you want the best

WATER SYSTEMS • GENERATING SETS • MOWERS • HAMMER MILLS • PUMPS
MAGNETOS • MOTORS • SCALES • DIESEL LOCOMOTIVES and ENGINES

What you ought to know about our water systems

Since electric water systems are *big* factors in helping you build up power loads, you ought to know all about them. So we've thought of ways to help you. First, we'll be glad to supply you with educational wall chart selection guides, and booklets showing types of pumps, their capacities and uses. Second, we'll loan you slide films showing installations of a new submersible pump. For complete details, mail the coupon!

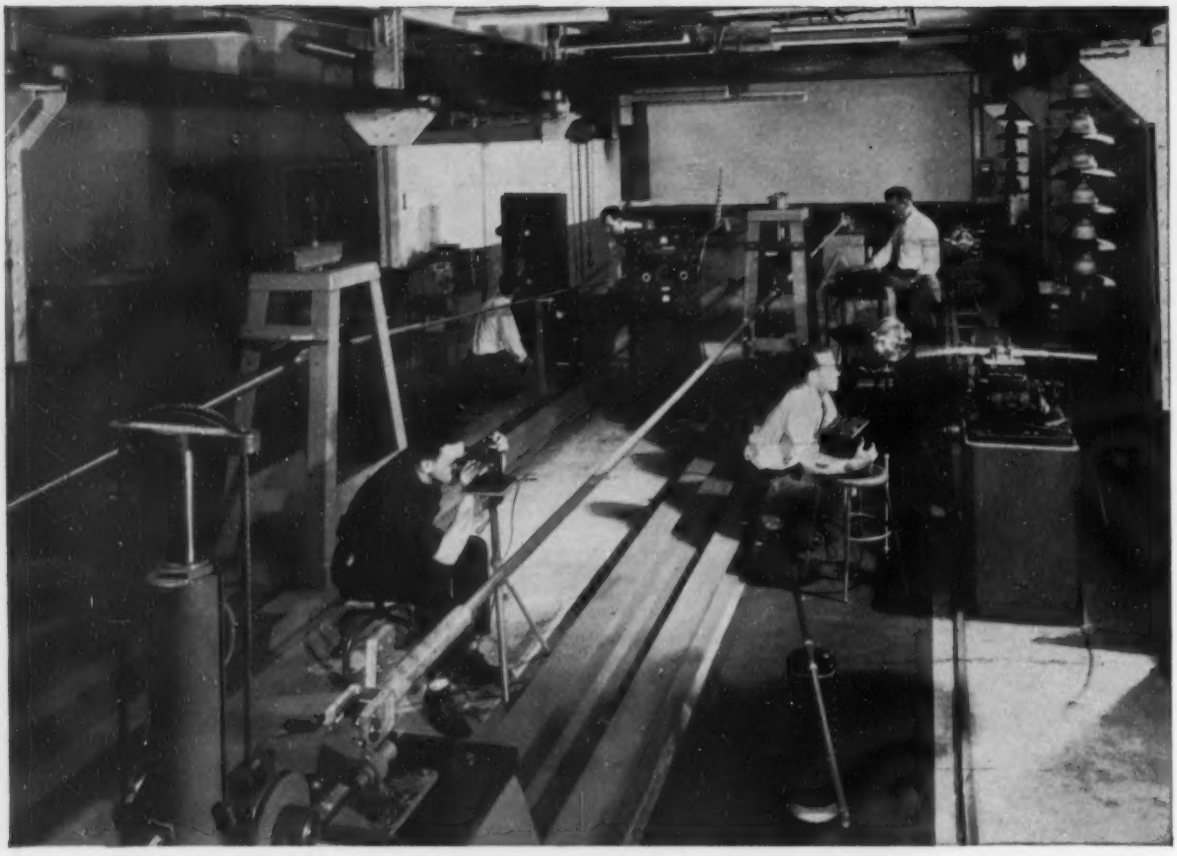
Fairbanks, Morse & Co.
600 S. Michigan Ave., Chicago 5, Ill.

Please send a representative to show us how to use your wall charts and interpret your literature on home water systems.

Name .....

Address .....

City ..... RD.... State.....



Progressive Ideas...

backed by **EXTENSIVE RESEARCH** *and* **SOUND ENGINEERING**

insure the ultimate in **FIELD PERFORMANCE**

The "ultimate in FIELD PERFORMANCE" is the installation that assures the longest satisfactory transmission and distribution line life. In terms of armor-rod function, this means the best protection against line failure caused by:

1 — CONDUCTOR FATIGUE occasioned by a continuing increase in operating and maximum tensile stresses incident to the introduction of stronger conductors and the building of lines with longer and longer spans.

2 — ARCOVER BURNING at or near suspension clamps and LIGHTNING PITTING anywhere along the line.

3 — CORROSION AND CURRENT-TRANSFER PITTING within suspension clamps, at or near taps and under splices.

4 — UNDUE HEATING of taps, splices and so on, caused by the differential expansion of dissimilar metals or of metal stressed beyond its elastic limit.

It is almost impossible, in the case of a line failure, to isolate one or another of the causes, but with Preformed Armor Rods, it is not necessary.

PREFORMED ARMOR RODS by virtue of their inherent and unique characteristics effectively take care of all the above-mentioned problems. Conductors are relieved of mechanical stress at points of support. They are protected against burning, corrosion and overheating, and all of this is done at every point of application with almost unbelievable uniformity and consistency.

Preformed Armor Rods are today's... not yesterday's... answer for increasing conductor life.

For complete details of their outstanding and exclusive features, write or phone Cleveland: EXpress 1-3571.

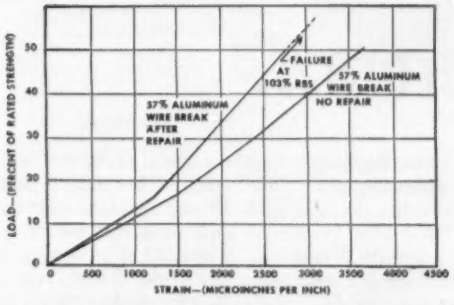
HOW *Preformed Armor Rods* LENGTHEN CONDUCTOR LIFE

★ The most vulnerable spot of a transmission line is under the suspension clamp. You can get no better armor protection than Preformed Armor Rods. They are always *uniform*—always do the same perfect job—factory engineered and factory formed—no variation in installation. Their intimate contact with the conductor provides the necessary reinforcement without any of the rub or chafe between rods and conductor, which you might expect in a looser installation. Furthermore, they will never loosen. They are not dependent on tightening of bolts which might crush the conductor if improperly applied—and which may become loose.

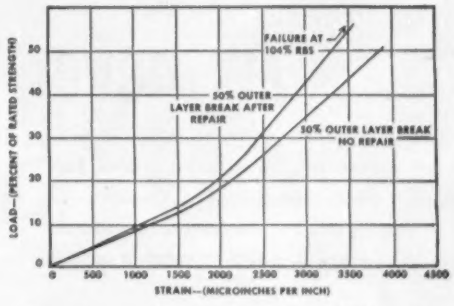
But this is only part of the story: While Preformed Armor Rods will provide the *best* and *safest* protection, they have another *unique* function—they do a job which only Preformed Rods can do. Regardless of armor efficiency, some vibration damage may occur. Should a strand failure occur at the suspension point, Preformed Rods will automatically take on the load, restoring strength and conductance—thereby continuing and lengthening conductor life.*

After all, your interest is in maintaining service—in continued functioning of your transmission lines. You need no longer consider the life of your conductor jeopardized by a strand failure. Preformed engineering has seen to this.

* Many have encountered vibration, chafing and burning failures on unarmored conductors and have used Preformed Armor for repairing and restoration of conductors at those points.


LOAD—(PERCENT OF RATED STRENGTH)
STRAIN—(MICROINCHES PER INCH)
37% ALUMINUM WIRE BREAK AFTER REPAIR
FAILURE AT 103% RBS
37% ALUMINUM WIRE BREAK NO REPAIR

Strength restoration of No. 4, 7 x 1 ACSR (rated breaking strength—2288 lbs.) by Preformed Armor Rods.


LOAD—(PERCENT OF RATED STRENGTH)
STRAIN—(MICROINCHES PER INCH)
FAILURE AT 104% RBS
50% OUTER LAYER BREAK AFTER REPAIR
30% OUTER LAYER BREAK NO REPAIR

Strength restoration of 795 MCM, 26x7 ACSR (rated breaking strength—31,200 lbs.) by Preformed Armor Rods.

These two charts tell the story. Irrespective of conductor size and construction, the clamping characteristics of PREFORMED Armor Rods result in restoration of the strength of damaged conductors to within at least 5 per cent of the rated breaking strength of the original conductors. And remember . . . only with PREFORMED Armor Rods . . . can laboratory tests accurately predict field service performance. There are no "average" installations.

PREFORMED LINE PRODUCTS COMPANY

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As never before...

Today we are all aware of the disastrous and far-reaching effects of a major industrial fire. Owners . . . management . . . employees . . . customers . . . almost every one suffers, in one way or another, when a serious fire strikes.

Could it happen to your plant? Now is the time to take a long, close look at your plant's fire protection measures. Remember, the local fire protection ordinances normally only set minimum standards. Compliance with these ordinances is no guarantee of fully adequate firesafety.

One way to be absolutely sure of the efficiency of your plant's fire protection facilities is to call in an expert C-O-TWO Fire Protection Engineer. He is ready and willing to help you with any or all industrial fire hazard problems.

There is a personal sense of responsibility inherent with C-O-TWO Fire Protection Engineers that assures you of fully adequate firesafety . . . a definite plus in your behalf. Whether it's fire detecting or fire extinguishing . . . portables or built-in systems . . . C-O-TWO means top quality backed by experienced engineering that results in operating superiority for you at all times.

WHEN BUSINESS STOPS . . . INCOME STOPS!

Don't take chances with your investment. Secure the benefits of highly efficient fire protection engineering today . . . our extensive experience over the years is at your disposal without obligation. Get the facts now!

C-O-TWO

MANUFACTURERS OF APPROVED FIRE PROTECTION EQUIPMENT

Squeez-Grip Carbon Dioxide Type Fire Extinguishers
Dry Chemical Type Fire Extinguishers
Built-In High Pressure and Low Pressure Carbon Dioxide Type Fire Extinguishing Systems
Built-In Smoke and Heat Fire Detecting Systems

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Sales and Service in the Principal Cities of United States and Canada

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Square D ML Panelboards give you . . .

LOWER INSTALLATION & MAINTENANCE COST
REDUCED "DOWN TIME"

SQUARE D's TYPE ML CIRCUIT BREAKER DISTRIBUTION PANELBOARDS

provide complete, 2-way protection through the use of thermal-magnetic breaker units. Costly "down time" is held to a minimum since circuit breakers can be reset quickly after the fault has been cleared.

Four circuit breaker frame sizes provide ratings ranging from 15 to 600 amperes, 250 or 600 volts.

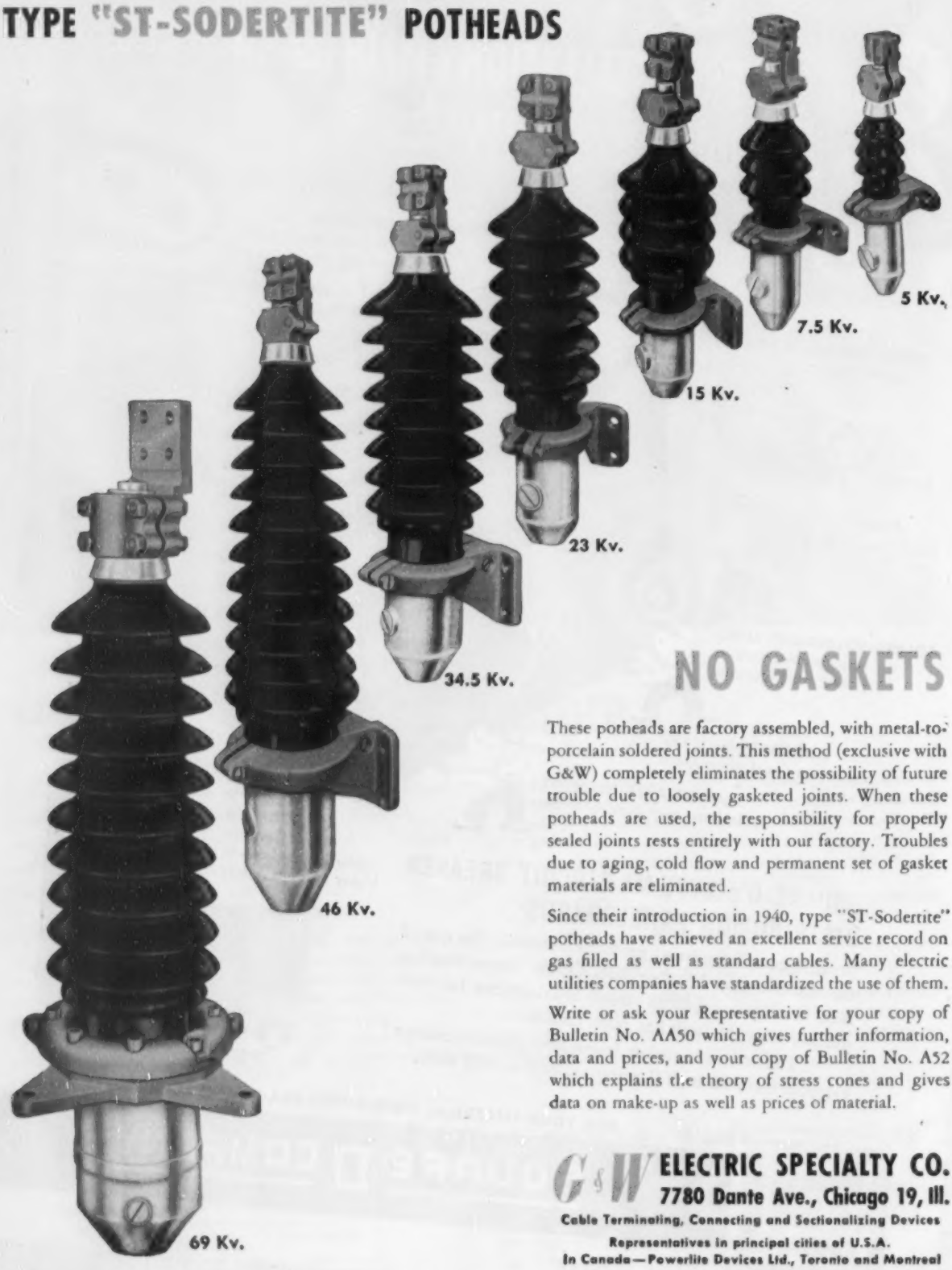
Type MLN

Type ML

ASK YOUR ELECTRICAL DISTRIBUTOR FOR SQUARE D PRODUCTS

SQUARE D COMPANY

ASSURE PERMANENT PROTECTION FOR CABLE ENDS WITH G&W TYPE "ST-SODERTITE" POTHEADS



NO GASKETS

These potheads are factory assembled, with metal-to-porcelain soldered joints. This method (exclusive with G&W) completely eliminates the possibility of future trouble due to loosely gasketed joints. When these potheads are used, the responsibility for properly sealed joints rests entirely with our factory. Troubles due to aging, cold flow and permanent set of gasket materials are eliminated.

Since their introduction in 1940, type "ST-Sodertite" potheads have achieved an excellent service record on gas filled as well as standard cables. Many electric utilities companies have standardized the use of them.

Write or ask your Representative for your copy of Bulletin No. AA50 which gives further information, data and prices, and your copy of Bulletin No. A52 which explains the theory of stress cones and gives data on make-up as well as prices of material.

G&W ELECTRIC SPECIALTY CO.
7780 Dante Ave., Chicago 19, Ill.
Cable Terminating, Connecting and Sectionalizing Devices
Representatives in principal cities of U.S.A.
In Canada—Powerlite Devices Ltd., Toronto and Montreal

Our long experience in working with both utilities and the public is your assurance of dependable work and good customer relations.

RESEARCH not guesswork brings results...

Bartlett clients have been amazed to learn how many different kinds of tree treatments and techniques are used by our dendricians. But when you think of the thousands of different insects, such as mites and scales, many of them invisible to the naked eye, which attack and destroy your shade trees, it is easy to see that successful results are dependent on accurate diagnosis and scientific controls. Research not guesswork brings results.

That's why we maintain the Bartlett Tree Research Laboratories at Stamford, Connecticut. In these laboratories and their 200 acres of experimental grounds, Bartlett scientists continuously study tree diseases and their proper treatment. The experience of these pathologists and entomologists is at the disposition of your local Bartlett representative which gives him the background and knowledge which untrained individuals could not possibly have.

For example, a client was perplexed by the discoloration of the leaves on one of his favorite shade trees. The local Bartlett representative was called in and found injury unknown to him. A specimen was immediately sent to our Tree Research Laboratories. Our scientists diagnosed the trouble and found an insect destructive to trees in other sections of the country but new to this area. A proper spray was recommended and feeding with Bartlett Green Tree Food. Today the tree is in a healthy, normal condition. Obviously, without the help of the laboratories, the trouble would not have been discovered and critical damage might have resulted. Efficient service like this is only possible when dendricians have the backing of knowledge and research.

It's no wonder those critical of results are turning to the Bartlett Way . . . the Scientific Way. You, too, can benefit by Bartlett services. Call your nearest local Bartlett office for a study of your tree situation.

You and your trees will be happy that you did.

BARTLETT TREE EXPERTS

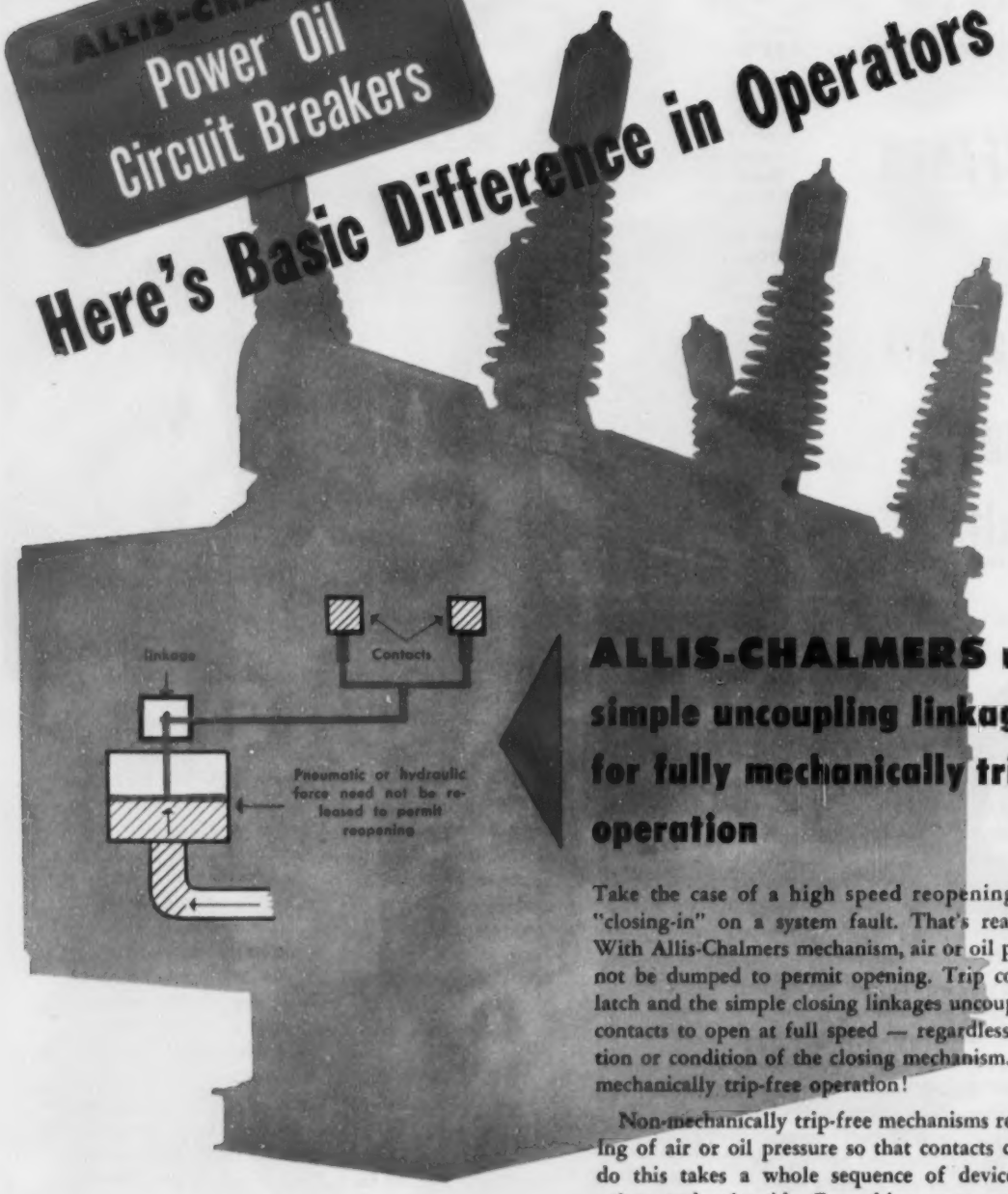
The Bartlett Way

Home Office, Research Laboratory and Experimental Grounds, Stamford, Conn.

Local Offices from Maine to the Carolinas, and West to Indiana. See your Local Telephone Directory for Local Address.

ALLIS-CHALMERS
Power Oil
Circuit Breakers

Here's Basic Difference in Operators



ALLIS-CHALMERS uses simple uncoupling linkage for fully mechanically trip-free operation

Take the case of a high speed reopening following "closing-in" on a system fault. That's really the test! With Allis-Chalmers mechanism, air or oil pressure need not be dumped to permit opening. Trip coil releases a latch and the simple closing linkages uncouple, allowing contacts to open at full speed — regardless of the position or condition of the closing mechanism. That's fully mechanically trip-free operation!

Non-mechanically trip-free mechanisms require dumping of air or oil pressure so that contacts can open. To do this takes a whole sequence of devices, including valves and solenoids. Everything must work perfectly, or breaker will be held closed or slowed in opening.

This truly simple operator principle has been a feature of Allis-Chalmers breakers since 1933. For further details call your nearby A-C district office, or write Allis-Chalmers, Milwaukee 1, Wisconsin.

A-4219

A-C ALLIS-CHALMERS

ALLIS-CHALMERS

Transmission Towers by AMERICAN BRIDGE handle nation's first 330,000-volt line

● The first leg of the American Gas and Electric Service Corporation's projected high voltage transmission network has been completed with the construction of a 63-mi. 330,000-volt, double circuit link running from Appalachian Electric Power Company's Kanawha River, W. Va., station to its Philip Sporn plant.

The towers for this record-setting line were designed and fabricated by American Bridge as the result of valuable data gathered from the A. G. & E. sponsored 500,000-volt test line at Ohio Power Company's Tidd plant, Brilliant, Ohio, in cooperation with other manufacturers of high voltage transmission line equipment.

These towers are approximately 150 feet tall and carry 6 conductors of 1,275,000 C.M., A.C.S.R. expanded cable (1.6"OD). The towers are designed for straight-line spans of 1700 ft.

The technical knowledge and field experience American Bridge has acquired in this and hundreds of other transmission line installations may be just the answer to your tower problems. Our engineers welcome an opportunity to figure with you without obligation. Just write to the nearest office listed below.

AMERICAN BRIDGE DIVISION, UNITED STATES STEEL CORPORATION
GENERAL OFFICES: 525 WILLIAM PENN PLACE, PITTSBURGH, PA.
Contracting Offices in: AMBRIDGE · ATLANTA · BALTIMORE · BIRMINGHAM · BOSTON
CHICAGO · CINCINNATI · CLEVELAND · DALLAS · DETROIT · ELMIRA · GARY
MEMPHIS · MINNEAPOLIS · NEW YORK · PHILADELPHIA · PITTSBURGH · PORTLAND, ORE.
ROANOKE · ST. LOUIS · SAN FRANCISCO · TRENTON
UNITED STATES STEEL EXPORT COMPANY, NEW YORK

DESIGN REDUCES FOUNDATION INSTALLATION COSTS. Important savings in time, labor, and materials were made possible through use of steel grillage earth anchors and variable leg extensions as shown above. Many other simplified installation and frill-free construction features are obtained through American Bridge designs.

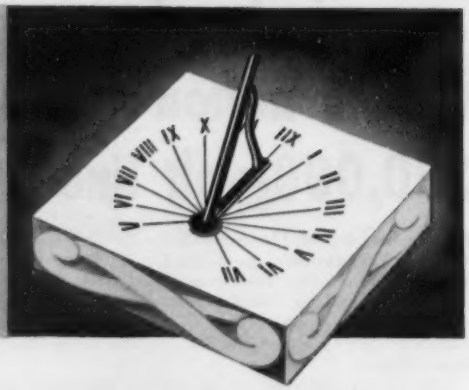
USS TRADE MARK

AMERICAN BRIDGE

UNITED STATES STEEL

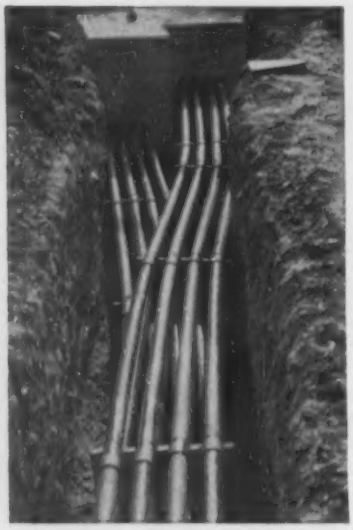
QUALITY

...proved by TIME...



Of course the most convincing proof of Orangeburg's enduring quality is its 60-year record of service to leading Public Utilities and Municipalities.

Quality stands out in every feature. Tough, resilient, non-metallic...Orangeburg Fibre Conduit does not easily crack or break. Its impermeable walls and tight joints keep out corrosive ground waters. Its smooth bore and low coefficient of friction protect cable sheaths from abrasion. Orangeburg material resists acids, alkalies, salt, grease, oil.



ORANGEBURG STANDARD is installed with concrete encasement. Preferred for banks of three or more ducts.

For these and other advantages Orangeburg provides complete security for electrical services underground. Result...no interruption of power. These vital services keep flowing.

SAVES MONEY, TOO!

Saves by prolonging cable life . . . by faster and easier handling, tooling and laying . . . and by the use of Orangeburg's standard fittings. They cut costs by simplifying installation. Send to Dept. EW34 for more facts.

ORANGEBURG MANUFACTURING CO., INC.
Orangeburg, New York
West Coast Plant — Newark, California

ORANGEBURG NOCRETE is installed without concrete encasement. Extra heavy wall for direct burial.

ORANGEBURG®
FIBRE CONDUIT

STANDARD INSTALLED WITH CONCRETE

NOCRETE INSTALLED WITHOUT CONCRETE

Graybar ELECTRIC COMPANY

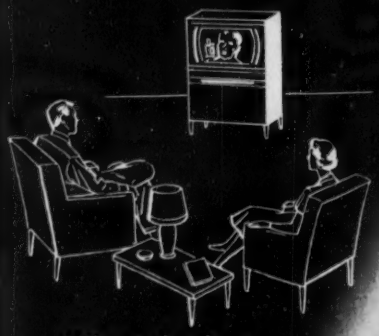
DISTRIBUTORS, ORANGEBURG FIBRE CONDUIT

BRANCHES AND STOCKS IN PRINCIPAL CITIES

GENERAL ELECTRIC SUPPLY COMPANY

A DIVISION OF GENERAL ELECTRIC DISTRIBUTING CORPORATION

Ne Plus Ultra...



Why take less
than the best?
It costs no more.

Eliminate INTERFERENCE

No Radio and Television Interference Developing at the Insulator!

Only Type "N" Gives You...

1. Fully-matured, vitreous glaze. Impervious to elements.
2. Constant composition—*uniform* conductivity in *all* parts of its mass.
3. Hard, smooth surface. Resists abrasion by conductor.
4. Will not abrade conductor.
5. Uniform composition guarantees constant and uniform characteristics.
6. You will quickly spot its distinctive color.

Ne Plus Ultra—there is none better! *Your customers' good-will* is too valuable to jeopardize with radio and television interference developing at the insulator. Porcelain Products Type "N" glazed "radio-freed" insulators are going up on more utility lines every day to satisfy this critical need. They will prove themselves on your lines. Write for details.

YOUR INDEPENDENT INSULATOR MANUFACTURER

Porcelain Products, Inc.
PARKERSBURG, W. VA.

Export Representative:
Philips Export Corp., 100 E. 42nd St.,
New York 17, New York, U. S. A.
Cable Address: "PHILYORK"

PP INC

Porcelain Products, Inc.
Parkersburg, West Virginia

Please send me more information about Type "N" Insulators.

Name_____ Position_____

Firm_____

Street_____

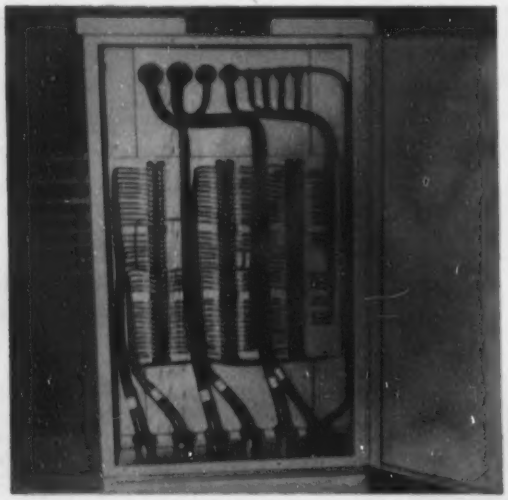
City_____ Zone____ State_____

A progressive approach to cable engineering pays off...

Rome cables chosen

Steel cable racks above relay cabinets. Glossy cable surfaces make Rome cables easy to install.

Power board No. 11, typical of control panels throughout the station.



Burner cabinet No. 2 for boiler No. 2. Note Rome thermoplastic control cables permit compact installation.

Typical relay cabinet for unit No. 2. Note neatness of installation afforded by Rome control cable.

GLENMONT STATION of Niagara-Mohawk Power Corporation is designed to supply electrical energy for a wide area, including Rome, Utica, Troy, Amsterdam, Canajoharie, Schenectady and Albany itself. Located along the Hudson River, it is the last word in power generating efficiency. Total rated capacity, when completed, 320 m-w.

for new Albany station

When utility engineers consider cables for their station planning, they thoroughly investigate available cable constructions from the standpoint of reliability, handling qualities, and neatness of appearance after installation. This was the case when Niagara-Mohawk Power Corporation engineers studied conditions connected with two recent station installations. And they found that Rome cable met these specifications.

There are many miles of Rome cable in the new Glenmont Station of Niagara-Mohawk now nearing completion near Albany, N. Y. Rome cables were also used in their Dunkirk Station, completed in 1951.

Four 80 m-w units are involved at Glenmont with provisions for further additions. Nearly 110 miles of Rome control cable and over 41 miles of Rome power cable have been supplied for this station.

CONTROL CABLES

The control cables are insulated with RoLene (polyethylene) and jacketed with Rome Synthinol. RoLene is practically unaffected by water, dc electro-osmosis, and low temperatures. It resists most chemicals, oxidation and oils.

The tough protective sheath of Rome Synthinol provides exceptional resistance to moisture, corrosion, abrasion and flame. Its aging characteristics assure long life under severest operating conditions.

POWER CABLES

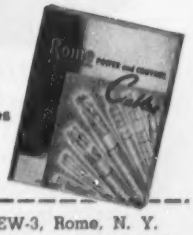
The power cables are insulated with RoZone and jacketed with RoPrene (Neoprene). A premium quality oil-base type of insulation, RoZone exceeds all requirements of ASTM specification D-574 assuring unquestioned dependability. It is resistant to corona action and aging. It shows high stability in water and possesses excellent electrical characteristics. As a further safeguard, every foot of power cable rated at 3000 volts and over is subjected to ionization testing as a standard manufacturing control. This test assures less maintenance problems.

VERSATILITY COUNTS

All Rome thermoplastic station control cables are adaptable to installation requirements. They may be installed in ducts, trays, or on racks—or used in circuits combining all these installation methods. They are recommended for operating temperatures up to 75° C. Versatility is one of the reasons underlying the preference of utilities, consulting engineers and industrials for Rome power and control cables.

(Left) Rome station control cable with RoLene insulation and a Rome Synthinol sheath . . . designed for installation in ducts or in air.

(Right) Rome power cable with RoZone insulation and RoPrene sheath . . . designed for installation in ducts or in air.



Let us send you our latest catalog on Rome Power and Control Cables

It Costs Less to Buy the Best

FILL OUT AND MAIL TODAY

ROME CABLE Corporation
ROME • NEW YORK
and
TORRANCE • CALIFORNIA

ROME CABLE CORPORATION, Dept. EW-3, Rome, N. Y.
Please send me a copy of the Rome Power and Control Cable Catalog.

Name .....

Company .....

Address .....

City ..... Zone ..... State .....

25% More CLAMPING FORCE!

Amazing CFC* Process Sets Impressive New Standards for Connector Performance

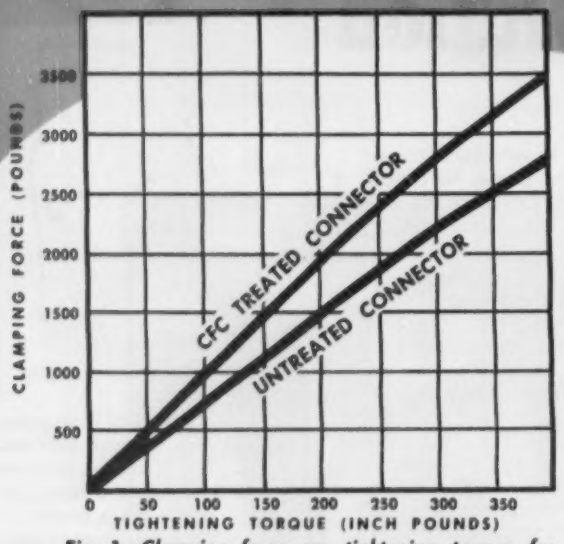


Fig. 1: *Clamping force vs. tightening torque for No. 2 stranded connectors, comparing CFC treated connectors with untreated connectors of the same lot.*

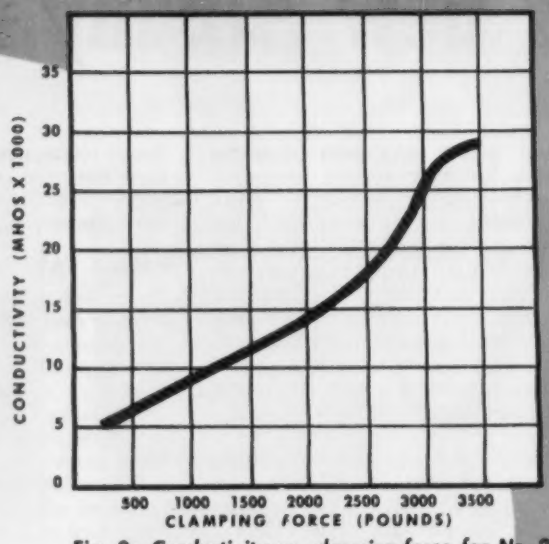
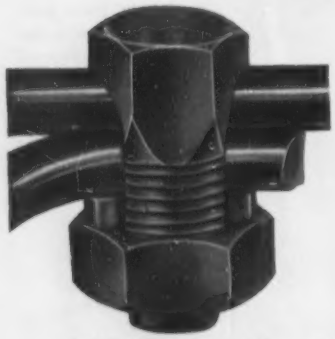


Fig. 2: *Conductivity vs. clamping force for No. 2 stranded hard drawn conductors.*



BLACKBURN'S exclusive chemical process for copper alloy connectors drastically reduces thread friction — increases clamping force — produces lower-resistance connections — and insures lasting, trouble-free service.

The above graphs show the great advantages of CFC treated Connectors. Note over 25% increase in clamping force. Note also how clamping force greatly increases conductivity of the connection. Thus, high clamping force, plus connector strength to **maintain** this force, gives you the **ideal** connection.

BLACKBURN Hi-Strength Connectors give you this **extra** clamping force — give you the **extra** strength to **hold** a maximum-pressure connection . . . Result — absolutely dependable connections that stay tight and trouble-free year after year.

**Chemical Friction Control Process — Patent pending*

JASPER BLACKBURN CORP.
35 MADISON ST., ST. LOUIS 6, MO.
Phone CEntral 3007

BLACKBURN *Hi-Strength* CONNECTORS

Ask a Lineman!

WIRE COVERED WITH "BAKELITE" POLYETHYLENE WEIGHS LESS • PULLS EASIER • STRIPS FASTER

No one knows better than "the man on the hooks" how BAKELITE Polyethylene makes his job easier!

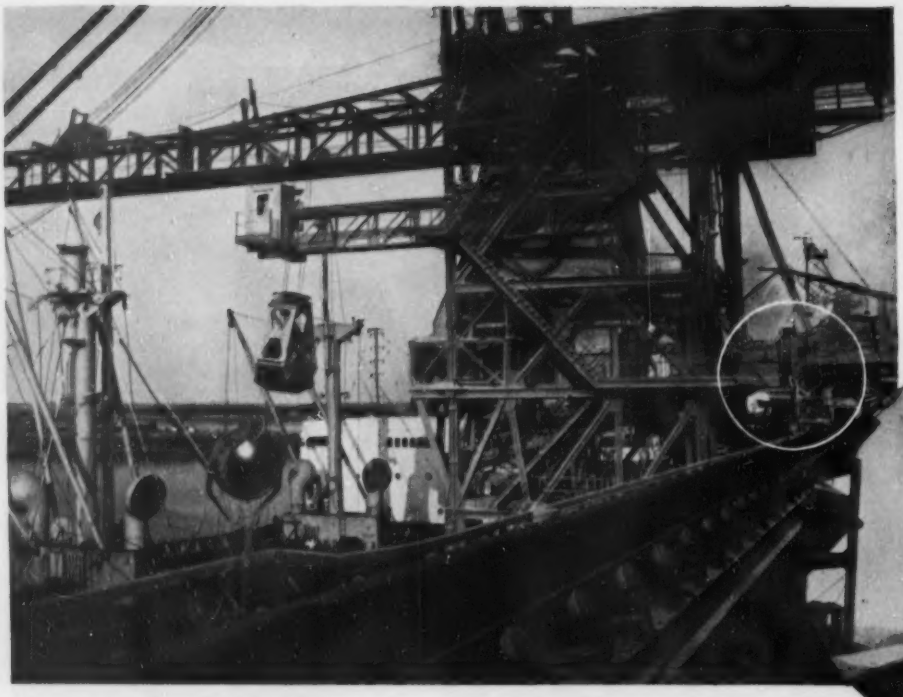
The excellent mechanical and electrical properties of BAKELITE Polyethylene compounds permit smaller diameters in line wire—for easier handling. These wax-smooth materials stay tough and flexible at —70 deg. C. . . . resist deformation in temperatures as high as 90 deg. C. BAKELITE Polyethylene won't festoon. It resists oil, grease, alkalies, most strong acids, abrasion and mildew. Tests with the black compound indicate a service life of several decades.

Get all the facts on BAKELITE Polyethylene for use in wire construction by writing Dept. UP-63. Ask for Kabelitems No. 48.

For Line Wire, Signal Systems and Service Drop— *wet or dry—the power factor of* BAKELITE *Polyethylene (black compound) is only 0.004 at 25 deg. C.; dielectric constant is 2.5. Electrical properties of polyethylene resin stay constant through a frequency range of 60 cycles to 50 megacycles. Temperatures in the vicinity of 90 deg. C. have little effect on electrical properties. Volume resistivity is so high it can be measured only by very sensitive instruments. Voltage breakdown resistance is excellent, even after long-term water immersion.*

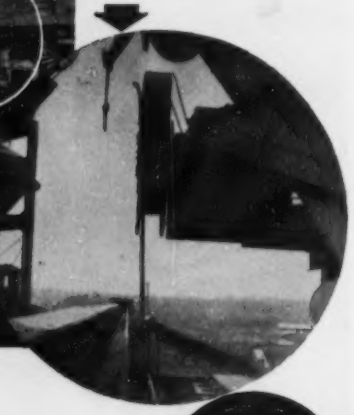
BAKELITE
TRADE-MARK
Polyethylene
WIRE COVERING

BAKELITE COMPANY, *A Division of Union Carbide and Carbon Corporation* UCC 30 East 42nd Street, New York 17, N.Y.
In Canada: Bakelite Company, Division of Union Carbide Canada Limited, Belleville, Ontario

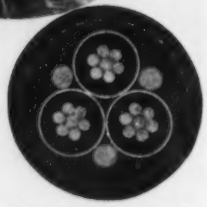


Alabama State Docks Bulk Material Handling Plant utilizes Hazacord in a unique take-up reel feeder for the overhead loading structure.

Close-up of the take-up reel shows the supporting bars for the cable alongside the conveyor belt.



Modern bulk material handling plant uses HAZACORD for SAFETY and DEPENDABILITY



Hazacord Type SH-D

Overhead loading structure power distribution at the new addition to the $5,000,000 Alabama State Docks Bulk Material Handling Plant at Mobile required a high safety factor as well as long-term dependability. Previous construction involved contactors riding on open bus bars which were frequently damaged by falling ore and were hazardous to personnel.

A constant torque take-up reel equipped with 650 feet of Hazacord Type SH-D supplies the power to the new loading structure. The 5,000-volt cable is supported as it is paid out by 14″ rods extending out from the side of the conveyor belt at 5′ intervals. The structure can move 630′ in either direction from the origin of the cable.

Such unusual installations as this indicate the wide variety of applications for the toughness and dependability of Hazacord Portable Cables. The tough Hazaprene sheath is resistant to the abrasion and compression as well as abuse from falling ore found in these operations. Weather resistance and the ability to withstand the attacks of acids, alkalies, moisture and most oils make Hazacords the logical choice for all portable power circuits up to 15,000 volts.

Your Hazard representative can recommend the correct Hazard cable for your requirements or write Hazard Insulated Wire Works, Division of The Okonite Company, Wilkes-Barre, Pa.

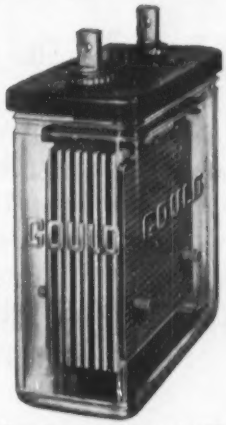
HAZACORD *Mold-Cured* **portable cables**

2134

Rugged and raring to go...

THANKS TO BATTERY POWER!

That's the advantage of using Gould Plantés—the standby batteries with PURE LEAD positive plates. Because these plates constantly renew the active material throughout their life, these Aristocrats of Stationary Batteries are always ready and raring to go. They last practically forever . . . are the lowest cost standby batteries you can buy. Standardize on Gould Planté!



Specify GOULD PLANTÉ— The Aristocrat of Stationary Batteries

GOULD INDUSTRIAL BATTERIES

GOULD-NATIONAL BATTERIES, INC., TRENTON 7, N. J.

Always Use Gould-National Automobile and Truck Batteries

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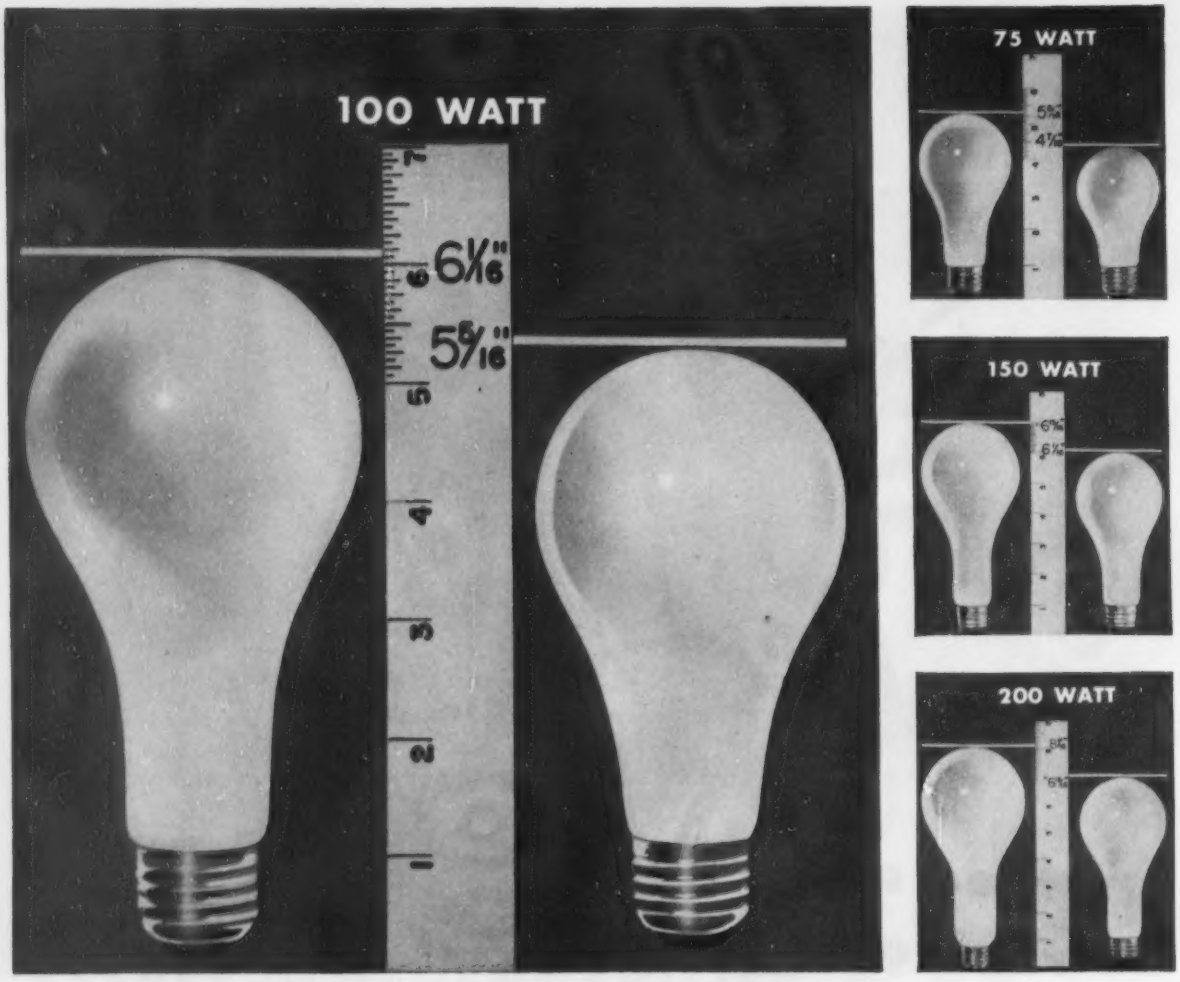
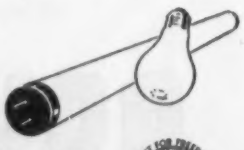


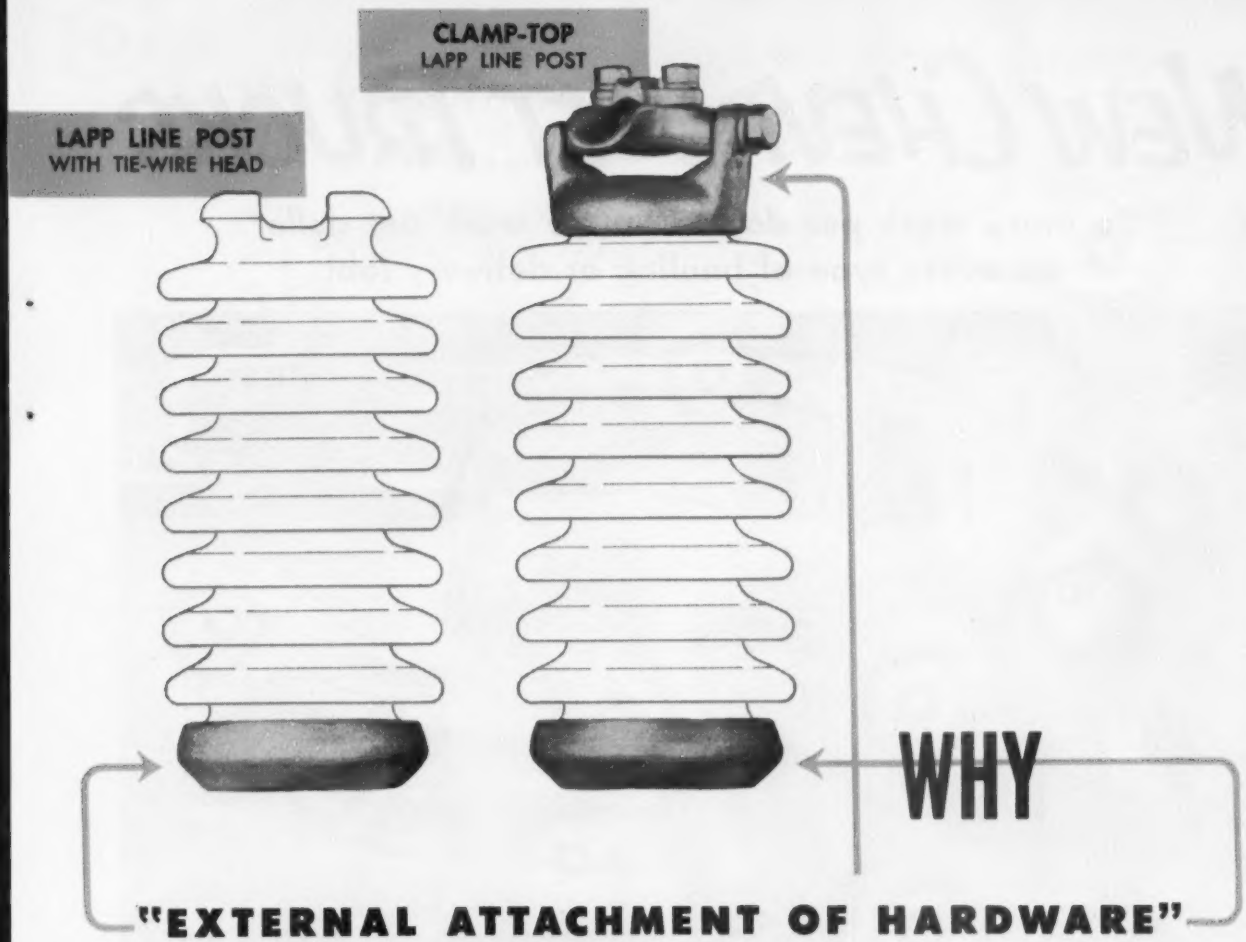
New Work-Lite family builds load

These smaller lamps, pioneered by Westinghouse, provide higher levels of illumination for the kitchen, laundry, garage, basement and other work areas. They are made to fit existing fixtures. And because Work-Lites stress better lighting instead of higher wattage, they are ideal for load-building programs.

To help you build load with Work-Lites and other lamps, we've prepared a 28-page booklet. It outlines 11 load-building promotions. To get your free copy, consult your local Westinghouse Lamp Representative, or write today to: Westinghouse Lamp Division, Bloomfield, N. J. No obligation, of course.



YOU CAN BE SURE...IF IT'S **Westinghouse**

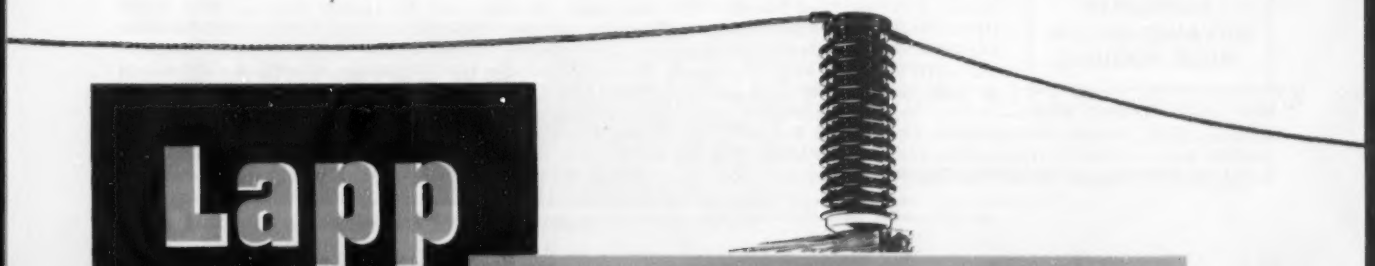


WHY

"EXTERNAL ATTACHMENT OF HARDWARE"

means greater operating security for **YOUR** transmission lines

Characteristics of Lapp electrical porcelain include a compression strength of 100,000 lbs., a tensile strength of 5,000-8,000 lbs. Lapp Line Posts are designed to utilize the greatly superior compression strength, by *external attachment of hardware*. No nested porcelain parts . . . no pins . . . no inserts . . . no bursting forces . . . no small-area high-intensity tension loading of porcelain under thermal movement or mechanical loading. Instead, the large-area gentle-grip of externally attached bases and caps. This is the design which depends on the *compression* strength of *porcelain*, and the tension strength of steel. It's a fundamental in the Lapp concept of better insulator design. It is one of the ways Lapp builds transmission insulators to give you an extra margin of operating security, long life, and low upkeep.



Lapp

LAPP INSULATOR CO., INC., LE ROY, NEW YORK

NEW CHEVROLET TRUCKS

do more work per *day* . . . more work per *dollar* on every type of hauling or delivery job!

Time and money are the two most important factors in any trucking job—and the new Chevrolet trucks for '54 are built to save more of *both!*

THEY SAVE YOU TIME *ALL THE TIME*

Whether you deliver door-to-door or haul state-to-state, new Chevrolet trucks will speed up your schedules. They bring you new hour-saving engine power—greatly increased acceleration and hill-climbing ability. You save time with greater safety . . . and *without* increasing your maximum road speeds. In traffic or on delivery routes, new truck Hydra-Matic transmission* saves time, and saves driving effort as well. It's the last word in no-shift truck driving.

THEY SAVE YOU MONEY IN *EVERY* WAY

Along with increased power, these great new trucks bring you increased operating economy. You enjoy hefty gasoline savings in every model, thanks to new high-compression performance. In addition, you save on upkeep and maintenance. That's because you get extra strength and stamina in drive line and chassis. There are heavier axle shafts in 2-ton models, newly designed clutches and stronger frames in all models.

See your Chevrolet dealer for all the facts about the "savingest" Chevrolet Advance-Design trucks ever built! . . . Chevrolet Division of General Motors, Detroit 2, Michigan.

MOST TRUSTWORTHY TRUCKS ON ANY JOB! CHEVROLET

CHEVROLET ADVANCE-DESIGN TRUCK FEATURES

THREE GREAT ENGINES—The new "Jobmaster 261" engine* for extra heavy hauling. The "Thriftmaster 235" or "Loadmaster 235" for light-, medium- and heavy-duty hauling. **NEW TRUCK HYDRA-MATIC TRANSMISSION***—offered on ½-, ¾- and 1-ton models. Heavy-Duty **SYNCHRO-MESH TRANSMISSION**—for fast, smooth shifting. **DIAPHRAGM SPRING CLUTCH**—improved-action engagement. **HYPOID REAR AXLE**—for longer life on all models. **TORQUE-ACTION BRAKES**—on all wheels on light- and medium-duty models. **TWIN-ACTION REAR WHEEL BRAKES**—on heavy-duty models. **DUAL-SHOE PARKING BRAKE**—greater holding ability on heavy-duty models. **NEW RIDE CONTROL SEAT***—eliminates backrubbing. **NEW, LARGER UNIT-DESIGNED PICKUP AND PLATFORM STAKE BODIES**—give increased load space. **COMFORTMASTER CAB**—offers greater comfort, convenience and safety. **PANORAMIC WINDSHIELD**—for increased driver vision. **WIDE-BASE WHEELS**—for increased tire mileage. **BALL-GEAR STEERING**—easier, safer handling. **ADVANCE-DESIGN STYLING**—rugged, handsome appearance.

**Optional at extra cost. Ride Control Seat is available on all cab models, "Jobmaster 261" engine on 2-ton models, truck Hydra-Matic transmission on ½-, ¾- and 1-ton models.*

to the far corners of the globe...

to bring you the MIRACLE of MICA

Nature's Own Insulating Material

Unequalled By Man

To get the best Mica, Macallen goes to the four corners of the earth — to isolated mines in remote regions. Mica is freighted out by sled, river barge or bullock cart. No easy task but Mica is worth it!

Combining high dielectric properties with high resistance to heat, Mica surpasses all man-made products as an insulating material. Though raw Mica is unexcelled for some purposes, processed Mica is more efficient and economical for most uses. And processing Mica is right up Macallen's alley! Consult us regarding your insulation problems — and profit by over half a century of experience.

when you think of MICA . . . think of MACALLEN

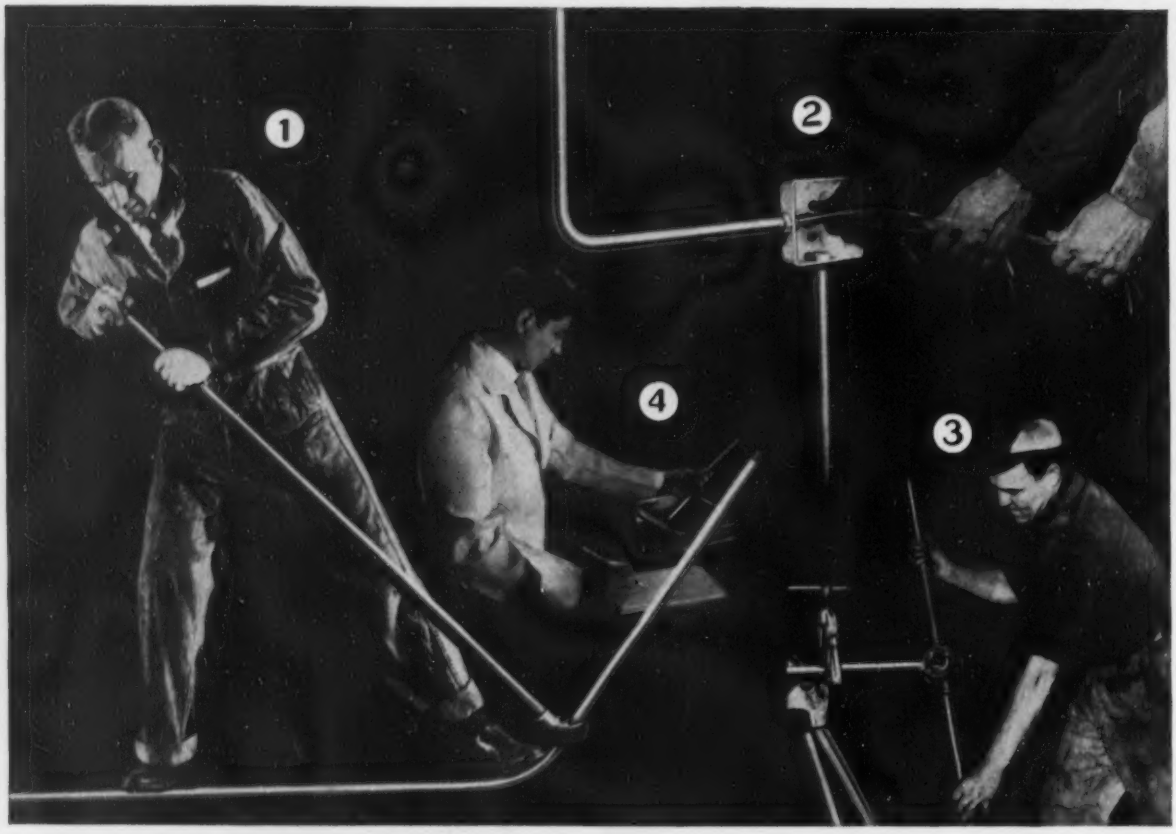
MACALLEN MICA

ALL FORMS, ALL QUANTITIES — ALL DEPENDABLE

THE MACALLEN COMPANY

BAY ROAD, NEW MARKET, N. H.

CHICAGO: 565 W. WASHINGTON BLVD. • CLEVELAND: 1231 SUPERIOR AVE.



NEW G-E WHITE CONDUIT

...easier to install...more resistant to corrosion

1. EASIER BENDING. The new G-E White is galvanized by metallizing, a process which locks a uniform coating of pure zinc to the conduit. Metallizing eliminates the excessive heat and the quenching and straightening used in other processes. The result is a more ductile conduit.

2. EASIER FISHING AND WIRE-PULLING. The tough, tightly-bonded, corrosion-resistant coating used inside the conduit contains a special antifriction agent. This provides a smooth interior surface that lets wires slide easily, and cuts fishing and wire-pulling time.

3. EASIER THREADING. The metallizing process produces a unique zinc structure that acts as an ideal cutting lubricant and makes threading at the installation site easier.

4. BETTER CORROSION PROTECTION. Metallizing bonds a uniform coating of pure zinc to the entire outside surface of the conduit, including threads. Grueling tests prove that new G-E White offers improved resistance to corrosion from smoke, heat, humidity, acid fumes, alkalies, and salt atmospheres. The C-553 organic coating over the zinc retards white rust and gives extra protection against rough handling.

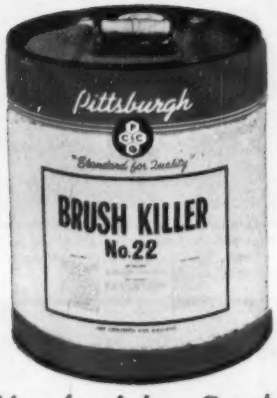
New G-E White rigid steel conduit conforms with the American Standards Association Specifications, is listed by Underwriters' Laboratories, Inc., and meets Federal Specification WW-C-581b, dated May 4, 1951. For more information ask your distributor about new G-E White, or write Section C46-327, Construction Materials Division, General Electric Company, Bridgeport 2, Connecticut.

You can put your confidence in—

GENERAL ELECTRIC

FOR SAFER, LONGER-LASTING BRUSH CONTROL—

Pittsburgh BRUSH KILLER No. 22



Standard for Quality

CLEARING brush from power line rights-of-way by hand or machine-cutting methods is costly, time-consuming and only temporary, at best. But you can do the job right the first time —and do it easier, safer and far more economically when you spray with *Pittsburgh* Brush Killer No. 22. Here's why:

EASIER—*Pittsburgh* Brush Killer No. 22 greatly simplifies your rights-of-way clearance problem. One crew of few men can kill more brush in hours than a dozen men can kill in days by hand. And the brush is killed right down to the roots.

SAFER—*Pittsburgh* Brush Killer No. 22 contains the highly effective low volatile Isooctyl ester that minimizes vapor drifts and possible damage to nearby crops. And it does not affect grass growth.

MORE ECONOMICAL—With *Pittsburgh* Brush Killer No. 22, you can clear your rights-of-way at far less cost per mile than by hand or mechanical methods. And cleared rights-of-way enable your maintenance crews to cover more miles per day, with savings in labor and equipment. ● Write today for complete details on *Pittsburgh* Brush Killer No. 22.

Graybar QUALITY SINCE 1869 *REG. U.S. PAT. OFF. *Distributed by* *Graybar* ELECTRIC COMPANY

AGRICULTURAL CHEMICALS DIVISION
PITTSBURGH
COKE & CHEMICAL CO.
Grant Building • Pittsburgh 19, Pa.

W&D 8095

COAL CHEMICALS • AGRICULTURAL CHEMICALS • FINE CHEMICALS • PROTECTIVE COATINGS • PLASTICIZERS • ACTIVATED CARBON • COKE • CEMENT • PIG IRON

BUSINESS CONSULTANTS

what do these two words mean to you?

They sum up an important aspect of the services Ebasco offers the electric power industry—*help at any time on any business problem.*

Whether that problem involves new financing, out-of-line costs, industrial relations, sales or any of dozens of equally significant factors, you can depend on Ebasco for a quick and practical solution. What's more, that solution is reached without burdening your permanent payroll or taking your own key executives away from their important operating functions.

Ebasco pools many specialized talents into one flexible, completely-integrated organization; can thus apply the appropriate man-power and mind-power, economically and effectively, to your specific situation.

Our booklet, "The Inside Story of Outside Help," gives a clear picture of the many Ebasco services and their helpfulness to business. For a copy, without obligation, write or phone Ebasco Services Incorporated, Dept. M, Two Rector Street, New York 6, N. Y.

BUSINESS STUDIES by Ebasco specialists analyze factors and problems affecting earnings and operation, aim at assisting business to operate more profitably.

SPACE PLANNING specialists help you achieve maximum efficiency of office and plant facilities. Ebasco has served many electric power companies in this capacity.

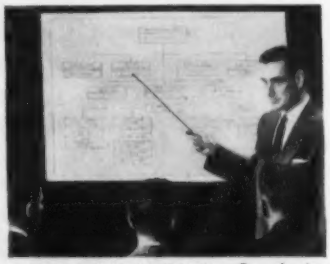
FINANCIAL CONSULTATION—Ebasco's Financial Consultants assist in reorganizations, changes in capital structure, registrations of securities and other fiscal matters. Ebasco has worked with companies in arranging more than $3,000,000,000 of financing.

ENGINEERS · CONSTRUCTORS
EBASCO
BUSINESS CONSULTANTS

NEW YORK • CHICAGO • WASHINGTON, D. C.

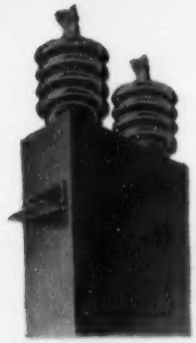
Appraisal • Budget • Business Studies
Consulting Engineering • Design & Construction • Financial
Industrial Relations • Inspection & Expediting
Insurance, Pensions & Safety • Purchasing • Rates & Pricing
Research • Sales & Public Relations • Space Planning
Systems & Methods • Tax • Traffic • Washington Office

Ebasco Teamwork gets things done anywhere in the world



SYSTEMS AND METHODS—Consultation on management techniques and procedures for planning and controlling business operations is offered by Ebasco specialists.

INSURANCE AND PENSIONS — Ebasco specialists aid companies in planning new programs or making present ones more effective. Ebasco offers an unbiased outside viewpoint, does not sell insurance.



This southeastern C-D capacitor installation is situated at the entrance to a large metallurgical smelter. Furnace temperatures run well over 3,000°F and the fumes are acidic. As a result these C-D capacitors are exposed to excessive temperatures and acid fumes that create a conducting electrolytic path leading to leakage and lower arc resistance of major bushing insulation. Yet, these C-D capacitors have given trouble-free service year after year, with little or no maintenance! It's another example of how C-D's superior engineering design that builds an extra margin of safety into each and every capacitor, pays off in the field year after year.

A C-D engineer can save you important maintenance dollars on your next power-factor installation. It will pay you to talk over your power-factor problems with him. No obligation, of course.

Cornell-Dubilier Electric Corporation, Dept.D-34A, South Plainfield, N. J.

There are more C-D capacitors in use today than any other make

CONSISTENTLY DEPENDABLE

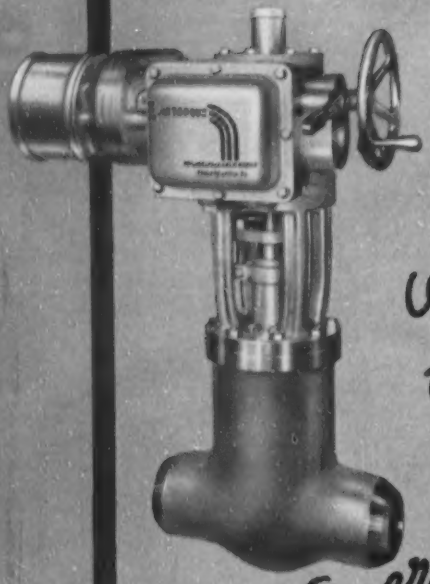
CORNELL-DUBILIER CAPACITORS

FOR POWER-FACTOR IMPROVEMENT

PLANTS IN SOUTH PLAINFIELD, N. J.; NEW BEDFORD, WORCESTER AND CAMBRIDGE, MASS.; PROVIDENCE AND HOPE VALLEY, R. I.; INDIANAPOLIS, IND.; SANFORD AND FUQUAY SPRINGS, N. C.; SUBSIDIARY: THE RADIART CORPORATION, CLEVELAND, O.

LIMITORQUE®

is absolutely dependable



what more can be said of any Automatic Valve Operator

The unfailing dependability of LimiTorque Controls to function surely, safely, instantly is proved every day in many of the leading power plants and central stations throughout the country. There is no guesswork connected with LimiTorque Control. One key man can open and close large or inaccessible valves by merely pushing a button, thus saving considerable time and man power, while assuring better coordination of plant operation. Damage to seats, stems and disc is prevented, because LimiTorque shuts-off the power if an obstruction occurs.

LimiTorque fits all types of valves and may be actuated by any available power source such as electricity, air, steam, water, gas or oil.

Philadelphia Gear Works, INC.

ERIE AVE. AND G ST., PHILADELPHIA 34, PA.

NEW YORK • PITTSBURGH • CHICAGO • HOUSTON • LYNCHBURG, VA.

Industrial Gears and Speed Reducers
LimiTorque Valve Controls

Solid-Silver to Solid-Silver Roller-Wipe Contacts . . .

on PACIFIC ELECTRIC

Types SW and SWA
Pole Top

AIR SWITCHES

These contacts in advanced form are used on Pacific Types SW and SWA Air Switches because they assure maximum reliability and minimum cost of upkeep.

The Type SW is similar, but has three insulators.

7.5 to 46 kv
400 and 600 amp
(Other Types 7.5 to 230 kv)

AIEE, ASA, and NEMA STANDARD

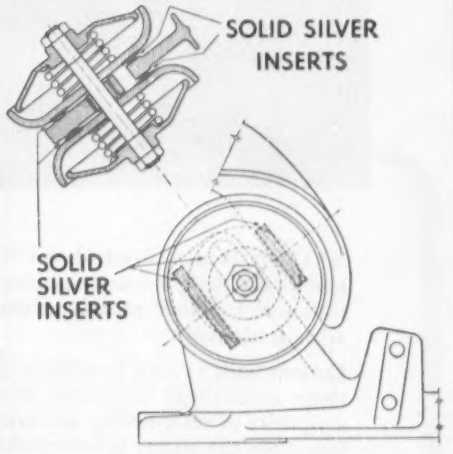
Type SWA 23-kv, 600-amp Switch Unit (a complete switch comprises three such units, operating mechanism, and usual accessories).

DURING PACIFIC'S 46 years of manufacturing air switches* numerous contact materials have been used, and applied in various ways. Unmistakably this experience points to thick silver inserts, silver-brazed to body and blade, as best meeting today's requirements—provided contact pressure is maintained between 50 and 90 lbs. Data in support of this are in Publication DS 195, "Design of Air Switch Contacts for Maximum Performance," mailed on request.

But it is not enough that suitable contact materials be used; the mechanical design must provide cool operation, low millivolt drop, low operating effort, minimum wear, and ample thermal capacity to absorb heat from short-time rated currents (15,600 to 40,000 amp for a 600-amp switch, depending on conditions). Adjustments also should be non-critical and capable of being made with a hot stick, if required.

Pacific Types SW and SWA Pole Top Air Switches generously meet these exacting requirements, and what is more important—maintain these qualities through years of non-use or years of frequent switching, as the other extreme. Catalog 114 describes all features of these switches.

* Pacific is credited with having made the first commercially used tilting-insulator air switch; it was introduced 40 years ago.



Current flows from body of blade through two roller disks that revolve slightly at each switch operation. During opening the roller assembly moves outward one inch before contacts start to part—an aid to progressive fracturing of ice.

All contact surfaces are faced with thick solid-silver inserts.

PACIFIC ELECTRIC • MFG. CORPORATION •

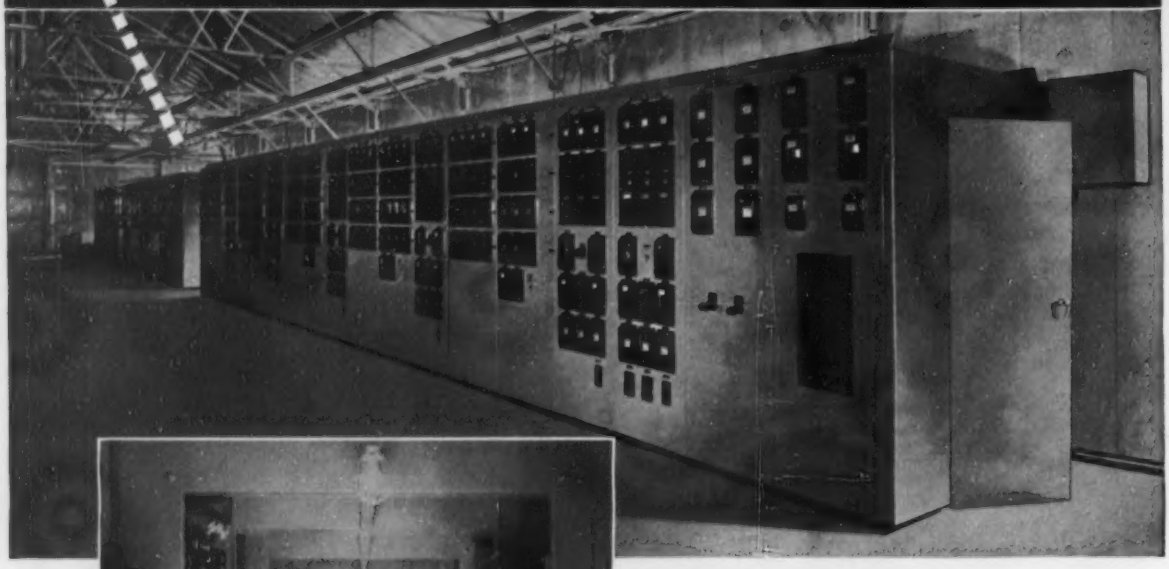
SUBSIDIARY OF FEDERAL ELECTRIC PRODUCTS COMPANY

5815 THIRD STREET, SAN FRANCISCO 24, CALIFORNIA
OTHER FACTORIES: SANTA CLARA, CALIF.; SCRANTON, PENNA.

Since 1906

SALES OFFICES or AGENCIES in PRINCIPAL CITIES

NELSON DUPLEX SWITCHBOARDS
offer many desirable features



Manufactured in two sections, this duplex control and relay switchboard is shown on factory assembly floor.

Interior of one section of the above switchboard is illustrated at left.

NELSON Duplex Control and Relay Switchboards are designed for metering, instrumentation and control of substations and generating stations.

Custom-built to each customer's specifications, these tunnel-type structures achieve utmost simplicity of inter-wiring and cross-panel wiring. They are sturdy in construction and provide maximum accessibility.

Wire guttering can be furnished with or without covers. Wiring on the rear of the panels is secured by flash welded studs in order to assure a smooth front surface.

When you need switchboards of this type, permit us to quote on your requirements.

Observe attractive appearance of this NELSON duplex switchboard.

NELSON Electric MANUFACTURING CO.
TULSA, OKLAHOMA

217 N. DETROIT AVE. **TELEPHONE 2-5131**

new catalog describes the
MOST ECONOMICAL HEATING SURFACE
ON THE **MODERN** BOILER

. . . that's the way to describe the Ljungstrom Air Preheater. For any boiler above 25,000 pounds per hour capacity — there's a Ljungstrom to cut your fuel costs . . . increase steam capacity . . . lower maintenance costs.

This new catalog includes detailed descriptions of the Ljungstrom Air Preheater, and illustrations showing how it is mounted on boilers of many different capacities. Included, too, are reasons why the Ljungstrom is so reliable . . . easy to maintain . . . resistant to corrosion.

FOR YOUR FREE COPY, WRITE TODAY TO THE AIR PREHEATER CORPORATION

The Air Preheater Corporation 60 East 42nd Street, New York 17, N. Y.

Compare

CHASE® COPPER BUS CONDUCTORS WITH ANY OTHERS . . . . . for capacity
. . . for copper savings
. . . for efficiency

Chase ventilated square tube buses can cut your copper requirements up to 36% as compared with flat rectangular bars.

The current ratings of some of the Chase ventilated square tube buses are given in the table to the right. Bear in mind that the square tube bus is a one-piece bus and is not a composite bus consisting of two or more parts.

Send for Chase Copper Bus Conductor booklet giving information on Chase ventilated square tube, flat rectangular and round copper tube buses.

CURRENT CARRYING CAPACITY OF ONE-PIECE BUS

	Square Inches	Current Rating at 40° C. Rise
7 x 7 x 3/8 Ventilated	9.06	7760
8 x 8 x 5/16 Ventilated	8.80	8400
9 x 9 x 1/4 Ventilated	7.93	8560

Chase BRASS & COPPER

WATERBURY 20, CONNECTICUT - SUBSIDIARY OF KENNECOTT COPPER CORPORATION

The Nation's Headquarters for Brass & Copper

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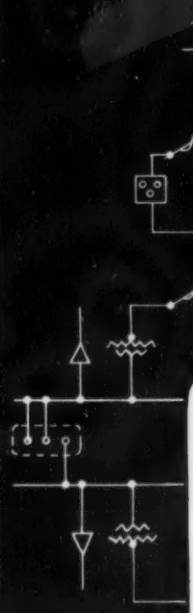
Chicago	Houston	Newark	Rochester †	(† sales office only)
Cincinnati	Indianapolis	New Orleans	St. Louis	

SUBSTATION STRUCTURES

One Responsibility
FROM DESIGN TO DELIVERY!



INDUSTRIAL INSTALLATION

R&IE

CENTRALIZED SUBSTATION SERVICE

Check the facts!

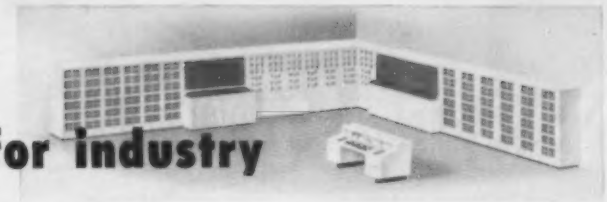
1. **DESIGN** layout, detail complete.
2. **FABRICATION** complete in R&IE shop.
3. **GALVANIZING**—new controlled methods.
4. **SWITCH ASSEMBLY** — from foundry and all machining operations, R&IE controls the entire manufacture ready for delivery.
5. **VERSATILITY** to solve any special problem. Illustration shows typical industrial application of R&IE design.

R&IE EQUIPMENT DIVISION

I-T-E CIRCUIT BREAKER CO.

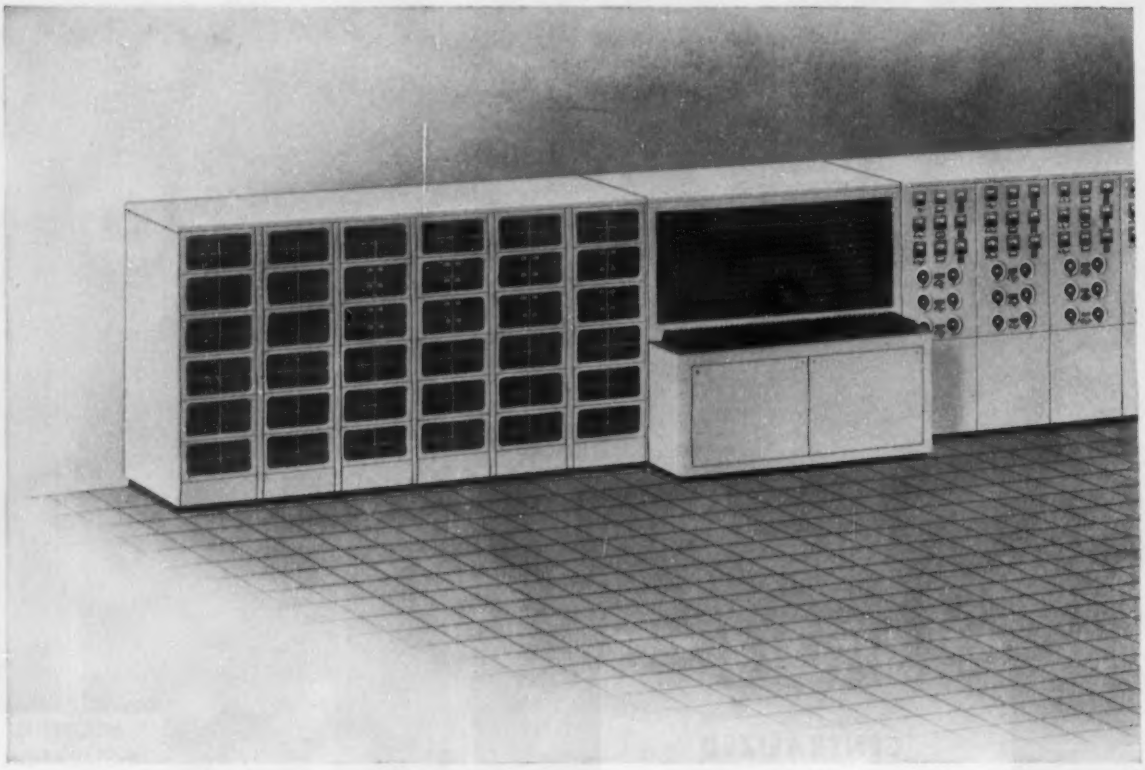
GREENSBURG, PA.

INDOOR BUS SUPPORTS and BUS FABRICATION • OUTDOOR BUS SUPPORTS and AIR SWITCHES • SUBSTATION STRUCTURES—steel or aluminum • TESTING DEVICES • KIRK KEY INTERLOCK SYSTEMS • ISOLATED PHASE BUS STRUCTURES • INTERRUPTER SWITCHES



Another service for industry

I-T-E now offers a complete line



I-T-E System Analyzer, with console metering desk, arranged for 21 generators and approximately 450 circuit components.

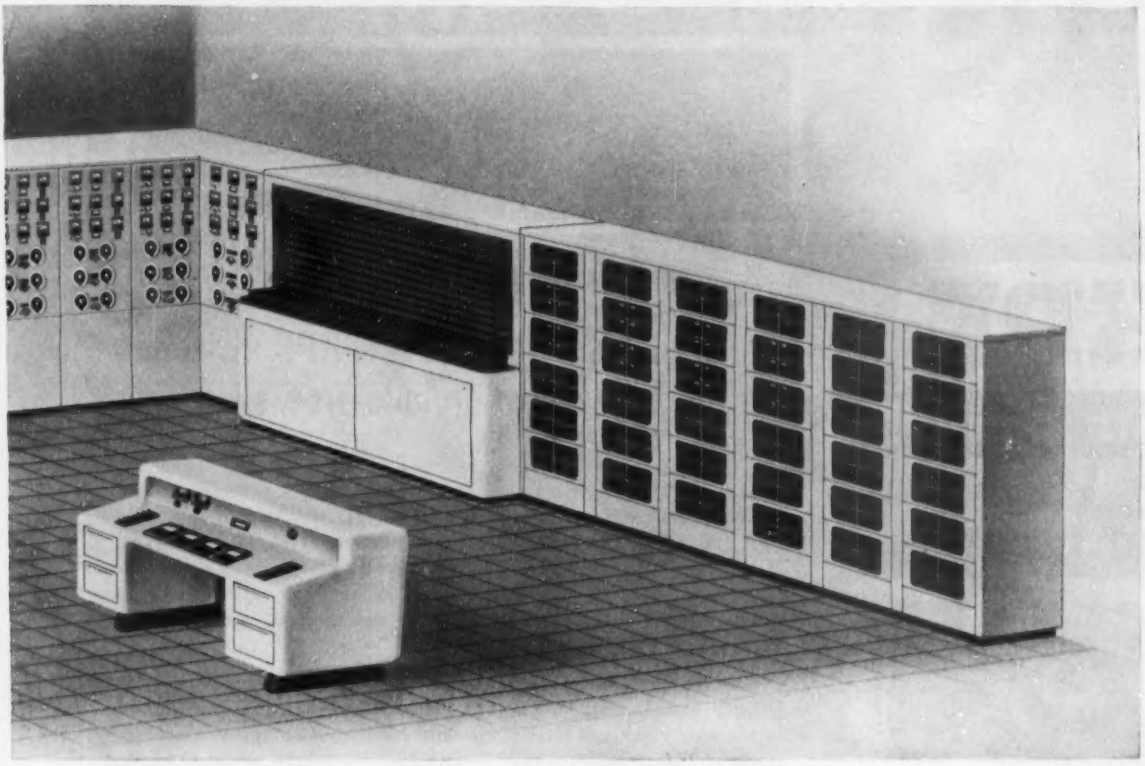
I-T-E continues to support America's greatest electrical expansion

KWHR capacity has doubled in the last ten years. Present trends indicate another doubling in the decade to come. More effective equipment for system planning, as well as new power-generation, transmission, and distribution equipment, will be required to handle this vastly increasing capacity.

Recognizing the need for more effective planning equipment, the I-T-E Circuit Breaker Company is making available a complete line of power system analyzers, designed for utmost accuracy and speed of operation. These analyzers provide solutions to system problems resulting from rapid growth and interconnections, and afford studies otherwise too difficult because of limited technical manpower and time. These units incorporate features covered by the patents and latest designs of Professor E. B. Phillips, University of Kansas.

I-T-E thus continues to support industry by providing more products, broader lines, and increased production of the finest-quality equipment.

# of POWER SYSTEM ANALYZERS



- 60 CYCLE POWER SUPPLY
- GREATER ACCURACY
- FASTER OPERATION
- COMPACT DESIGN
- MINIMUM MAINTENANCE
- SIMPLIFIED INSTALLATION

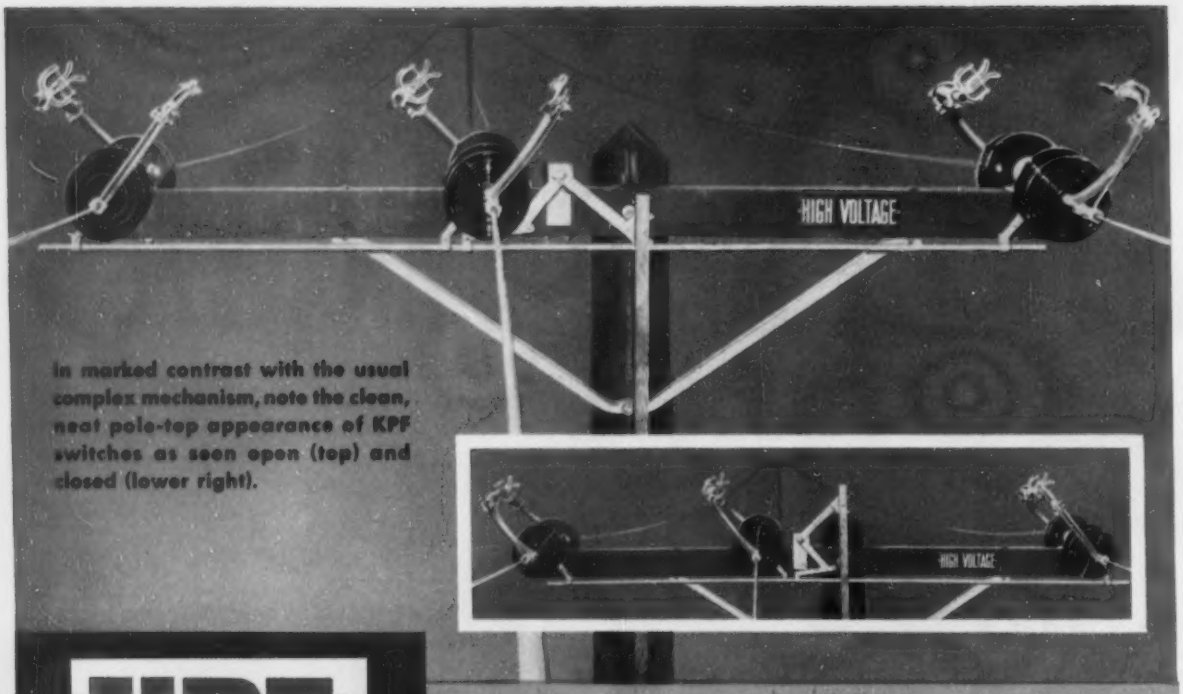
For details, contact the I-T-E Field office nearest you. Look in your Classified Directory under "Electric Equipment."

The Symbol of Quality Switchgear

I-T-E CIRCUIT BREAKER COMPANY

19TH AND HAMILTON STS., PHILADELPHIA 30, PA.

SYSTEM ANALYZERS



In marked contrast with the usual complex mechanism, note the clean, neat pole-top appearance of KPF switches as seen open (top) and closed (lower right).

KPF

AIR BREAK SWITCHES

Standard for nearly half a century

Here's why service-proved KPF switches give more years of trouble-free switching

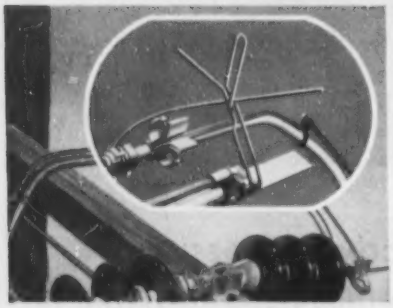
KPF Air Break Switches look different because they *are* different. They are the simplest air break switches made. They consist of two rigid dead-end insulator assemblies with rigid jumpers forming the switch arms. One assembly is mounted stationary to the cross-arm. The other rotates to make and break the circuit. There are no complex parts to get out of order, require lubrication, adjustment or other service. Once installed, sturdy KPF switches serve indefinitely.

Simple design also means simpler manufacturing and lower cost. No separate dead-ends or extra insulators are required.

Finally, installation time is less than half normal. Phase units are shipped ready for use and need only be bolted to the cross-arm.

KPF Air Break Switches have been used for almost 50 years on lines ranging from 7.5 to 110 kv. Tens of thousands are in use today by Pacific Gas & Electric, Southern California Edison, Minnesota Power & Light and other leading power companies.

For the world's simplest, surest, lowest cost air break switch, specify KPF—standard for nearly 50 years.



Since KPF pioneered the Quick-Break attachment over 5 years ago, leading utilities have been dropping up to 40 miles of 69 kv line without dangerous arcing. KPF Quick-Breaks have a heavy-duty cat's whisker that whips free in a split-second as the switch is opened. Establishment of an arc is prevented; hence, critical arc length is not a problem. KPF Quick-Break attachments are available from stock for all KPF switches built since 1940.

New catalog gives complete specifications, detail drawings, installation information.

KPF ELECTRIC COMPANY

1624 East Alpine Avenue, Dept. E-2, Stockton 5, California

$ensible $aving

is the smart reason for the 20 ft. length of these rolls. You get this size in the 10-roll container of *Gold Seal* Plastic Tape. For companies that supply tape to many workers for varied jobs, it's the best buy. "Tape-saver" size, we call it. It's enough for the average job . . . footage of "lost" tape is kept low. Workers like the small size, too. It "swings" easy in tight places. And remember, you start saving the minute you say

GOLD SEAL
plastic tape

It gives you the many plastic tape advantages, with the plus of proved Gold Seal quality. With the warranty of Jenkins Tape specialists, you can be sure it will speed the job, stick right, and stand up under toughest conditions. Try it . . . sample free on request. Jenkins Bros., Rubber Division, 100 Park Ave., New York 17.

Gold Seal Plastic Tape — single 60 ft. rolls in round metal cans and Handy Pack of ten 20 ft. rolls.

JENKINS

Gold Seal Tape

FRICTION • RUBBER • PLASTIC

Single rolls and 10-roll containers. Also Diamond Seal Friction and Rubber Tapes made to ASTM Specifications. Products of Jenkins Bros. — makers of famous Jenkins Valves.

In the winter of 1870-1871 three miles of Kerite telegraph wire were laid from the weather observation post on top of Mt. Washington, N. H., to the railroad station at the base. At great hazard, men laid the wire over a high trestle on Jacob's Ladder and on the ground where it was subjected to the most severe conditions. The performance of Kerite insulation was largely responsible for keeping these lines of communication open.

PERFORMANCE

Kerite's unique and exclusive cable insulation has been unexcelled for dependable performance in the past century.

The value and service life of a product can be no greater than the integrity and craftsmanship of its maker.

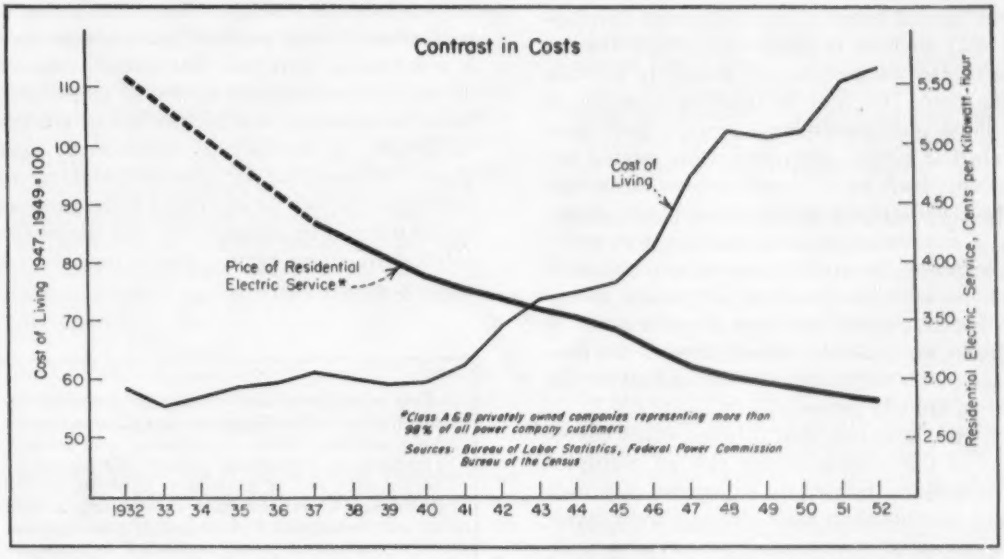
KERITE CABLE

THE KERITE COMPANY—30 Church St., New York 7, N. Y.
Offices also at 122 S. Michigan Ave., Chicago; 582 Market St., San Francisco; 3901 San Fernando Rd., Glendale 4, Calif.; 31 St. James Ave., Boston

A 20-YEAR RECORD...

The Electric Power Companies' Case for Public Confidence

An economic study of the record of the investor-owned electric power companies of the United States over the past twenty years underwrites their claim to public confidence today. A key factor of this record is set forth by the chart in the middle of this page. This shows that while the cost of living as a whole has almost doubled, the average price of electric energy for residential use in the United States has been cut in half.



The average prices of industrial and commercial power also are much lower than they were twenty years ago.

Such a study confirms the record on other key accomplishments of the electric power companies during the past two decades.

They have not failed, either in peace or war, to meet the nation's rapidly expanding electric power requirements. In paying tribute to the performance of these companies during World War II, J. A. Krug, Director of the Office of War Utilities, said, "Power has never been too little or too late." The same can be said for the entire period of the past twenty years.

To be ready with enough power -- on time -- the electric power companies have expanded their production fourfold since 1933. This has required an investment of over $17 billion in new facilities. To raise the funds for this investment they have enlisted the participation of about 3 million direct stockholders. Through life insurance companies, banks and similar institutions, about 90 million Americans -- more than half of the nation's total population -- have become investors in electric power companies. By thus relying on private investment for their expansion, the power companies have provided their

plant and operating equipment without burden on the taxpayer.

In addition, the investor-owned companies have paid about $12 billion in taxes to various governments – national, state and local – over the past twenty years. Unlike government-owned and -operated systems, they have received no public subsidies. When taxes and subsidies are taken into account, the rates for electricity charged by the investor-owned companies have been as low as, or lower than, those charged by government-owned and -operated systems.

Many Americans do not appreciate the job that the power companies have done over the past two decades. That is due, in part, to the public memory of financial abuses by some utility holding companies during the 1920's. This memory obscures a clear and unprejudiced view of the progress since those days. And some of the all-out advocates of reliance on government rather than on regulated private enterprise for the development of our power resources do their best to keep this memory of the past alive in the present.

An Impressive Case

Some special cases of electric power development may involve problems for which the investor-owned companies are unable to provide full solutions. This may be true, for example, of some large multiple-purpose projects that combine electric power generation with related developments such as the improvement of navigation, flood control and the irrigation of arid lands. Some of the economic and administrative problems imposed by such projects are not well adapted to effective handling by private enterprise. Flood control and the improvement of navigation, for example, usually involve the provision of much costly service over and above the cost of producing power.

It is true, however, that in some cases development of the electric power side of multiple-purpose projects by private enterprise may well be more feasible than would appear from statements by some government power advocates. And the record indicates that even in those projects on which both the power generation and the other services are handled by public authority, it may well be desirable to have the investor-owned companies assume the transmission and distribution functions.

Our study of the record of the investor-owned and -operated companies over the past twenty years has led us, of course, behind the statistics that bear on the wisdom of giving them a priority in the development of our power resources. It reveals that these enterprises are manned by people who, through lifetime experience, are peculiarly conversant with the needs of the communities they serve. They have given the consumer notably good service while conforming to standards set and enforced by public regulatory commissions. They have won the confidence of the investing public. By their nature and their experience they are competent to handle any power program that can be demonstrated to be economically sound.

The Paramount Public Interest

By their economic performance during the last twenty years, the electric power companies have earned the confidence of the public. By relying on these companies to meet its electric power requirements the public will fully protect its economic interest in ample and efficient service at fair prices.

That is where our study comes out. Our findings do not touch the political consideration that private operation of electric utilities under public regulation is a safeguard against further concentration of both political and economic power in a federal government that already commands too great a concentration. But if these findings make an economic case for preferring power development by tax-paying business as against power development by governmental agencies, they clear the way for an appeal to the paramount public interest in safeguarding our personal and political freedoms against the further encroachment of government.

This message is one of a series prepared by the McGraw-Hill Department of Economics to help increase public knowledge and understanding of important nationwide developments that are of particular concern to the business and professional community served by our industrial and technical publications.

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Donald C. McGraw

PRESIDENT

McGRAW-HILL PUBLISHING COMPANY, INC.

THE ELECTRICAL WEEK

The Issue's News Highlights . . . Duquesne Light will go into partnership with AEC to develop nation's first utility-sized nuclear power plant.

FPC suffered a setback when Supreme Court ruled Federal Power Act does not abolish proprietary rights, granted under state law, to use waters of navigable stream for power purposes. Niagara Mohawk was victor in the suit . . . Senate Public Works Committee is conducting hearings on bills proposing state and private development of additional power at Niagara Falls.

200,000 Mw of atomic power by 2000 A. D. That's the achievement brought within sight by the start of the 60-Mw nuclear power plant project by AEC, Westinghouse, and Duquesne Light (See Page 90), according to R. P. Petersen, chief of AEC's industrial reactor branch. In a talk before the Atomic Industrial Forum in New York, Petersen said cost of reactor-produced power must be brought down to 5.9 mills per kwhr to capture half the generation field on a competitive basis.

At the meeting, Dr Alberto F. Thompson, chief of the commission's technical information service, announced the forum, with headquarters at 260 Madison Ave, had been designated the first special repository for atomic energy information for industry.

James G. Beckerley, director of AEC's classification office, told the group the passing of atomic secrets to Russia by spies had been greatly overemphasized. Technical atomic achievements of the Soviet Union, he said, came "primarily through the efforts of Soviet scientists and engineers backed up by a ruthless totalitarian resolve to dominate the world." He urged declassification of more non-weapons data so U. S. atomic scientists and engineers would be better able to compete.

New York State Association of Electrical Workers, AFL, urged development of additional power at Niagara by private utilities in a letter to Senate Public Works.

Consumers Power and Michigan Utility Workers Council—CIO will meet April 7 with Gov G. Mennen Williams' fact-finding panel to try to settle contract differences.

REA-financed cooperatives and certain other enterprises previously exempt from Michigan's Business Receipts Tax have been made subject to the tax by an amendment signed by Governor Williams.

General Electric Co discharged five employees of its Lynn, Mass., plant who had refused to answer questions of Sen Joseph R. McCarthy's Permanent Investigations subcommittee. The men had been suspended three months ago with orders to "clear" themselves.

Off the Washington Wire . . . Work on the controversial Table Rock hydro project in Southwest Missouri is scheduled to resume after a one-year stoppage. House public works and appropriation groups gave the power installation a green light for an initial installed capacity of 100,000 kw, with provision for doubling that in the future. The action clears $2.3 million for use on the $78.6 million White River plant.

After whacking nearly 10% off the Administration request, the House approved and sent to the Senate last week a $308 million funds bill for construction by Army Corps of Engineers during the next fiscal year. Money for the 16 multiple-purpose projects, however, was voted pretty much as the President had asked, save for technical curtailments on Garrison Reservoir and The Dalles Lock and Dam. The Senate will likely restore some of these construction funds.

REA has approved a $1,630,000 generation and transmission loan to Rural Cooperative Power Association, Elk River, Minn., to extend and improve service to six distribution member co-ops in east central Minnesota.

President Eisenhower refused to commit himself on reappointment of Gordon Clapp as chairman of TVA. A delegation headed by States Rights Finley of the Chattanooga Power Board called on the President and handed him a petition containing 60,000 signatures urging the Chairman's continuance . . . If Clapp fails to win reappointment, he may find himself on the New York City payroll: he reportedly is being considered for the post of city personnel director.

Westinghouse Pres Gwilym A. Price urged the company's stockholders to write their Congressmen telling them it is in the country's interest that the government buy electrical equipment from American manufacturers only. In a letter to shareholders, Price said Westinghouse has lost almost $8 million worth of orders on government contracts to foreign firms over the last two years. He said these firms could underbid the company because they pay lower wages and "do not have the expense of maintaining an adequate service organization in this country."

Executive Changes . . . Donald C. Luce, vice president in charge of combined operations of Public Service Electric & Gas Co, was elected president to succeed George H. Blake, who retired. Lyle McDonald, a vice president, was appointed chairman of the board.

"A 20-Year Record—The Electric Power Companies' Case for Public Confidence," an editorial on the page opposite, is also appearing in all McGraw-Hill domestic publications and in newspapers in 11 major cities. About 55,000 reprints have been mailed to top executives in industry, political leaders, publishers, labor representatives and educational leaders.

Duquesne, AEC: Atom Power Partners

Pittsburgh utility's broad proposal provides that company will:

- **Furnish site for entire project**
- **Build, operate generating portion of plant at own expense**
- **Operate reactor part of plant, paying labor costs**
- **Contribute $5 million toward research, development, construction costs of the reactor portion of plant**

Duquesne Light Co of Pittsburgh is going into partnership with Atomic Energy Commission to develop, build, and operate the first utility-size atomic power plant.

The $45-million plant with a minimum capacity of 60,000 kw is to be located in the greater Pittsburgh area on land now held by the electric company. "Firebox" for this first big plant of its kind will be a pressurized water reactor (PWR) of the basic type that will power the submarine Nautilus.

Negotiations Continue . . . Negotiations continued in Chicago last week on the formal contract between AEC and Duquesne on the terms of the partnership. Acceptance of Duquesne offer was announced March 13.

Scope and terms of Duquesne's offer came as something of a shocker to both industrial and government circles. It was taken as a solid indication of the interest which private industry has in putting the atom to work for industrial and commercial purposes.

AEC Chairman Lewis L. Strauss figures the Duquesne partnership will save the government some $30 million in out-of-the-pocket expenses during construction and the first five years of operation of the project.

The Proposal . . . Under the Duquesne proposal, the company would:

- Furnish a site for the entire project and build and operate a new electric generating plant at no cost to the government.
- Operate the reactor part of plant and bear labor costs thus entailed.
- Assume $5 million of the cost of research, development, and construction of reactor portion of plant.
- Pay AEC at the rate of 48.3¢ per million btu's of steam used in the turbines for the first year; the rate increasing annually until it reaches 60.3¢ in the fifth year under the plan.
- Waive any reimbursement by the government of costs incident to termination of the contract.

Westinghouse Electric Corp of Pittsburgh was previously awarded contracts for development, design, and construction of the reactor portion of the plant (EW, Nov. 2, '53, p 74).

'Greatly Honored' . . . In commenting on AEC's acceptance of the company's offer, Philip Fleger, chairman of Duquesne Light's board, declared:

"The company is greatly honored by its selection to participate in this historic project. Recognizing the scope of the national interest that is involved, we are prepared to cooperate in every possible way with the Atomic Energy Commission. We are ready to start the necessary work as soon as a formal agreement with the government has been negotiated."

Westinghouse Pres Gwilym Price had this to say:

We are naturally delighted that our industrial neighbor Duquesne Light Co has joined the pioneering adventure and the Pittsburgh area now will play an even greater role in the development of peace-time atomic power."

PHILIP FLEGER, Duquesne's board chairman: "Company is greatly honored . . ."

AEC Surprised . . . AEC officials had hoped for sizable contributions from industry on the first large atomic power plant, but few had expected a single company to step forward with an offer as broad as that submitted by Duquesne. From a financial standpoint, the PWR cannot be expected to compete with other conventional, coal-fueled generating plants now operated by Duquesne. This is mainly an experimental venture, and reactor experts generally concede that the PWR will be technically obsolete by the time it is on the line. By this, they mean that more advanced and more economical reactors will probably be in the design stage by the time that the PWR is finished.

For that reason, AEC expected industry to join in the experiment to gain technical information but not as a business partner.

Puzzlement . . . Utility spokesmen were hard-put to explain the Duquesne proposal. They pointed out that the company is right in the middle of the Pennsylvania coal fields where fuel is cheapest. The rate which the company will be paying for nuclear-heated steam will be considerably above that which it pays for coal-heated steam.

Industry men had thought that utility men in high-cost fuel areas would have a lot more incentive to go in for atomic power than did Duquesne. But they believed the plant would more likely be located near one of the large power-using AEC installations.

One government official who has kept a close eye on the PWR offered these explanations:

- Duquesne made the offer because it is a progressive firm sincerely interested in advancement of the art of electrical generation. The company teamed up last year with the Walter Kidde Nuclear Laboratory, Inc of New York City to study the feasibility of nuclear power.
- AEC accepted the offer because it was far and away the best of the nine sizable offers submitted.

Ft Randall Dam, built under Pick-Sloan Plan by Army Engineers, checks flow of Missouri at Pickstown, S. D.

Ike Signals Start of Ft Randall Unit

President Eisenhower last week pushed the button in the White House which turned on the first generator at South Dakota's Ft Randall Dam—the biggest hydro-power unit so far operational in the Pick-Sloan Plan for the development of energy in the Missouri River Basin.

At the ceremony, attended by Congressmen and other officials with an interest in the project, Eisenhower restated his Administration's policy on future power development.

Eisenhower called water "our greatest asset"—a natural resource that could cause tremendous damage if uncontrolled, but when properly used "can be our greatest resource."

"We must find the best and most intelligent way, through federal, state and local agencies, to develop this resource," the President said. "It is my ambition to make certain that these means are found."

Ft Randall's 40,000-kw unit was the first installment of 1.2 million kw eventually to go on the line from four mainstem dams being built under the Pick-Sloan Plan.

When President pushed button in Washington, he raised dam's control gate sending water through turbine blades

States' Rights Upheld in Niagara Suit

- **Supreme Court ruling asserts state authority supreme over water power rights in navigable streams**
- **Verdict is blow to FPC regulatory powers**
- **Effect on private company development of power from Falls in doubt**

The Supreme Court last week upheld state authority over water power rights in navigable streams—thus tossing another complication into the current public-private fight over further Niagara power development.

The decision, handed down in a case involving Federal Power Commission and Niagara Mohawk Power Corp, also throws a legal shadow over the federal license granted city of Tacoma for its Cowlitz project and over several FPC actions involving the amortization funds of licensed projects.

In upholding a Court of Appeals decision, the high court said that state-granted water-use rights do not "evaporate" when encompassed in a federally licensed hydroelectric project (EW, Jan. 12, '53, p 58).

Federal Setback

Outcome of the case is interpreted as a sweeping setback for federal regulation over power development on navigable streams. FPC General Counsel Willard W. Gatchell, who argued the case in both courts, has said such a view would have the effect of a "state veto" over water power development.

He argued before the high court that the Federal Power Act confers on FPC authority to license the use of navigable streams for power production without compensation to prior holders of water-use rights. Not only may Congress abolish such rights without compensation, said Gatchell, but it did so in the Federal Power Act.

In its majority opinion, written by Justice Harold Burton, the court met this issue head on. Referring to the Federal Water Power Act, which is now Part I of the Federal Power Act, the majority wrote:

"The legislative history of the act discloses no substantial support for the drastic policy which the commission seeks to read into it. To convert this act to one automatically abolishing pre-existing water rights on a nationwide scale calls for a convincing explanation of that purpose. We find none. In fact the legislative history points the other way."

The majority also agreed with the lower court that the Federal Power Act supplements rather than abrogates state-granted water-use rights. Said the court:

"Riparian water rights, like other real property rights are determined by state law. Title to them is acquired in conformity with that law. The Federal Water Power Act merely imposes upon their owners the additional obligation of using them in compliance with the act."

The majority does not deny the long-accepted proposition that Congress may exercise absolute power over the improvement and use of navigable streams. It does hold, however, that such authority was not exercised in the Federal Power Act under which FPC operates.

Besides Burton, the majority included Chief Justice Earl Warren and Justices Felix Frankfurter and Tom Clark. Siding with the majority on the key issue were Justices William O. Douglas, Hugo L. Black and Sherman Minton, although they dissented as to the application of the principle involved.

Justices Stanley F. Reed and Robert H. Jackson took no part in the decision.

The Dispute

The dispute grew out of a 1950 FPC order which directed Niagara Mohawk to exclude certain payments it had made for water-use rights in figuring its amortization reserve fund for a federally licensed project. The Commission contended that these water rights "evaporated" when the license was issued in 1921 and hence on compensation was required.

Effect of the FPC order would have added $399,000 to the company's amortized reserve account for its Niagara project.

The majority agreed with the company that the water-use payments are valid expenses of the power project and hence should not be allocated to the amortization reserve. The three-man minority approved the payments as legitimate expenses, but said FPC might disallow them if it wished to do so.

For noted constitutional lawyer John W. Davis, former Democratic presidential candidate who argued for Niagara Mohawk, this was another in a long line of victories before the Supreme Court. But whether he had won this case at the risk of losing a later and more important case for his client, legal observers were not sure.

May Cause Turnabout

Both government and private attorneys see in last week's decision a possible block for private development of additional power at Niagara Falls. Niagara Mohawk, the principal in the case, is one of five New York electric companies seeking to develop an additional 1.1 million of power at the Falls. Last year the House passed a bill which would direct FPC to grant a license to the private firms for this purpose. This bill is presently before the Senate Public Works Committee, where it is being bitterly contested by New York State which favors public development.

If, as some observers think, the court decision gives state authorities a veto over federal water-power licenses, New York State would almost certainly turn down any license granted to the five companies.

Gov Thomas E. Dewey recognized the importance of the Supreme Court case and filed an amicus curiae brief asking that the lower court opinion be affirmed (EW, Oct. 26, '53, p 6). He also asked the Supreme Court to affirm the existence of state water-use rights both above and below the Falls where the additional power project is proposed.

The majority declined to deal with these claims, noting only that they were not a part of the case at bar. It is freely predicted that Governor Dewey

will rely heavily on the court action to thwart any further move by the electric companies to develop additional power at the Falls.

One possible way for the companies to avoid this legal tangle would be for Congress to expressly abolish any existing state water-use rights in the portion of Niagara to be developed. The court has said Congress has this authority.

The hitch here is that this would require significant changes in the private company bill already passed by the House—changes that might well be opposed by states' rights legislators.

Other Effect

At the other end of the map, the court decision could have a telling effect on the validity of the FPC license granted Tacoma for the Cowlitz project. Washington state authorities have sought to void the license on the grounds that it is contrary to fish conservation laws. The question arises as to whether Tacoma has acquired sufficient state water-use rights to make it eligible for the federal license it now holds.

FPC has in several other cases disallowed expenses for payment of water rights which it said did not exist. Now that the Supreme Court has ruled differently, companies may ask a correction in previous FPC orders. But the commission will not undertake to make the adjustments unless specifically demanded by the companies affected.

Niagara Hearings Continue

Sponsors of various measures under consideration by Senate Public Works Committee testify on behalf of their bills

The debate over development of additional power from Niagara Falls was moving toward a climax in the Senate this week. But as the hearings before the Senate Public Works Committee wore on, the odds more and more favored a stalemate—that is, no legislation at all this session.

Sponsors Heard . . . This week the committee finished hearing Congressional sponsors of bills and prepared to hear from representatives of labor and rural cooperatives—both groups expected to advocate public development. So far, no private power spokesmen have asked to be heard. No final action by the committee is expected this week, but it could come in the next week to ten days.

The general situation is this:

The House has passed—by a 2-to-1 margin—a bill giving the additional power from Niagara Falls to five New York State private utilities. The House is unlikely to depart from this stand.

The Senate committee is leaning more and more toward legislation that would turn over development of any additional power from Niagara to New York State Power Authority. Distribution would be over transmission lines belonging to private utilities.

Deadlock Possible . . . And should the Senate finally go this way, the prospects clearly point to a deadlock, and no legislation out of this Congress to expand electric power production so badly wanted in the Niagara area.

As the hearings opened, Sen Herbert H. Lehman (D-N. Y.) testified on behalf of the Lehman-Roosevelt bill which provides for state development with preference in the sale of the power to municipals, cooperatives and neighboring states. He claimed this bill was superior to the Ives-Becker bill (state development with no preference clause) and branded the Dondero-Miller-Capehart bill (private development) "an outright giveaway of a public resource."

The New York Senator also criticized the Case bill which would leave the decision on Niagara power to the Federal Power Commission. This, said Lehman, "abdicates Congressional jurisdiction over the Niagara resource, passing the buck to the Federal Power Commission."

Case Defends His Bill . . . Sen Francis Case (R-S. D.) defended his bill and charged that the Lehman-Roosevelt bill subordinated the power requirements of the 95% of New York's pop-

Senator Lehman (center) of New York testifies before Senate Public Works Committee on his Niagara bill

ulation served by private companies to the needs of preference customers in neighboring states.

In his testimony Rep Franklin D. Roosevelt, Jr, devoted a good deal of his time to an attack on the state development plan backed by Gov Thomas E. Dewey. He said mass use of the power can be attained if preference is granted to the municipals and co-ops.

Supports Private Bill . . . In urging support of the private enterprise bill, Rep George Dondero (R-Mich.) declared that public interest dictates prompt favorable action on the Capehart-Miller-Dondero bill. In discussing the question of turning the matter over to FPC, Dondero declared "The only problem here is one of highly important public policy which should be decided only by the Congress, namely, whether we are going to permit any form of government, for the first time, in the entire history of hydroelectric development, to enter the pure electric power business."

The significant development on Niagara power may have been the recent appointment by Dewey of Robert Moses to be chairman of New York Power Authority. Moses came to Washington last year to testify forcefully in behalf of returning tidelands to the states. Now, the so-called tidelands members of the committee, S. L. Holland (D-Fla.) and John Stennis (D-Miss.), are believed to have switched from private development to state development under Moses.

Attack by Moses . . . In a letter to Sen Edward Martin (R-Pa.), chairman of the committee, Moses said that the passage of the Capehart-Miller bill would be "robbery." He added: "The record shows that the worst possible procedure from the viewpoint of public interest would be to turn over the waters of the Niagara to the five utility companies."

On the other hand, he declared that public development by the authority "would save the consumers an enormous amount every year."

Even if the private power bill is approved by the Senate committee, it seems almost certain to set off a classic "private vs public power" debate on the Senate floor which would jeopardize passage this session. It's the one piece of legislation before Congress which would provide a clear-cut debate on the power issue.

DAVID O. SELZNICK

Jubilee TV Producer

David O. Selznick, noted Hollywood producer, has been selected to produce the Light's Diamond Jubilee television show.

The two-time Oscar winner is expected to draw on top stars of stage, screen, and television for the show which will be his first television production. The two-hour program will be telecast Sunday, Oct. 24.

To date, 145 companies, both utilities and manufacturers, have pledged their support of the Jubilee television show.

New York Bank Offers Plan to Finance Rewiring Costs

National City Bank of New York has announced a plan to help purchasers of appliances finance rewiring costs. In cooperation with the adequate wiring program of the electric industry, their selected appliance and air conditioning dealers may participate in a new arrangement whereby the cost of requisite special wiring can be included with financing the sale and installation of such appliances as electric ranges, dryers, dishwashers and air conditioning units.

The cost of the "special" wiring (not to exceed 40% of the selling price of the appliance) is to be listed on the contract, separately. When wiring is included in a contract, the minimum down payment is 20% of the combined cost of the appliance and wiring. Maximum number of months for repayment vary: Air-conditioning units (window type), 24 months; dish washers, dryers, ironers, ranges, 36 months.

Missouri Basin . . .

. . . steam plants needed to back up energy of federal projects, Aandahl tells utilities, co-ops

Interior's Assistant Secretary Fred G. Aandahl was key spokesman at meetings held recently in Denver and Casper, Wyo., on development of steam plant energy sources in the Missouri River Basin.

The Denver meetings, held March 9-10, were attended by representatives of private utilities and Rural Electrification Administration cooperatives in the Rocky Mountain area.

Aandahl had this advice to offer at the Denver meetings: Private utilities and REA co-ops in the Rocky Mountains will have to find sources other than federal government plants for their growing power needs after 1956.

Plan for Steam Plants . . . Meeting with the private companies the first day and the co-ops next, Aandahl had the same report to both: Begin planning steam plants at once to take care of your needs after 1956.

Private utilities were told by Aandahl, "We feel we can see you through 1956. After that the problem falls to the non-preference customer who must find additional power."

Expected animosity from REA groups over the new power marketing criteria failed to develop. Vance Austin, manager, Colorado State Association of REA Co-operatives, said, "Everything Aandahl had to say was fairly acceptable."

Dissenting Issue . . . There was only one point which both sides pressed for an answer and which both sides failed to get. It was the Interior's policy on 61,000 kw which private utilities in the Western Division of the Missouri River Basin received last December. Utilities' contract for that month was 41,925 kw.

Although the utilities have expressed no claims to the 61,000 kw, they told Aandahl they needed to know what was going to be done with that power before they intelligently could plan steam plants. But Aandahl refused to answer either the utilities or co-ops.

Other items in the week's news will be found starting on page 185.

New Contracts . . . At the conclusion of the second day meeting with the co-ops and representatives of municipally owned plants, Aandahl directed Bureau of Reclamation officials to start negotiating new contracts, getting preference contracts out of the way first. New contracts are necessary at this time because of availability of 115,000 kw of new power in that area.

Wyoming Parley . . . Vast power developments for Wyoming were envisioned at the meeting of federal, state, private and public power officials in Casper March 1.

J. Elmer Brock, chairman of the Wyoming Natural Resource Board, said huge deposits of tungsten, titanium, and uranium need electricity for full development.

Brock proposed the 350 leaders at the meeting unite behind this program:

1. Construction of a 1.6 million-kw steam plant at Lake De Smet.

2. Build a 230-kv transmission line, 155 miles from Casper to Sheridan by way of Lake De Smet.

3. Build a 115-kv, 270-mile transmission line from Lake De Smet to Glendo, site for a proposed Reclamation hydroelectric plant.

Backs 'Local Participation' . . . Brock asked the Bureau of Reclamation to participate in constructing the lines. Aandahl, however, said, "The bureau has no plans presently for transmission lines such as have been asked." Instead, Aandahl said, "We're very anxious to see local groups get together and take the initiative on such projects as these."

W. D. Johnston, vice president, Mountain States Power Co, told the meeting that his firm had been studying for more than two years possible sources of new power. He said the Lake De Smet site offered the best possibilities for a thermal plant.

Another steam plant is proposed at Pine Bluffs in southwestern Wyoming near the Nebraska-Colorado borders, about 300 miles from the Lake De Smet area. Marion M. Wilson, president, Tri-State Generation & Transmission Association, said the REA group hopes to build the plant with a $10 million federal loan. He added that REA Administrator Ancher Nelsen had given a "tentative approval."

Roy Zook, assistant administrator of REA, told the group his agency would do everything possible to help Wyoming's power problem.

J. H. JEWELL, president of Nema and vice president of Westinghouse Electric Corp, introduces L. H. Haeger (left), National Association of Home Builders, who addressed luncheon meeting

Effective Wiring Promotion . . .

. . . can be attained if utilities concentrate their efforts on appraisers, lending agencies, FHA, and VA, Nema luncheon told

The electrical industry can be most effective in its promotion of adequate wiring if it concentrates its efforts on appraisers, lending institutions, and Federal Housing Administrations and Veterans Administration, said Leonard G. Haeger, director, National Association of Home Builders Research Institute, in addressing the luncheon meeting of the National Electrical Manufacturers Association, in Chicago on March 8.

Most builders, said Haeger, are conscious of the value of adequate wiring to the home owner and the home owner wants adequate wiring, but appraisals, from long habit, are based on minimum wiring requirements. Any wiring above minimum standards increases the down payment required and therefore reduces the builder's market. Therefore, said Haeger, the job is to educate the lending agencies and there are signs that some progress is being made there. New standards having larger panels and larger service entrances are beginning to be reflected in lending policies and should be accepted within the next three or four years, he said.

Haeger urged that an electrical industry committee work hand in hand with a building industry committee to establish a voluntary national standard for a proper service entrance, and work to gain recognition of this cost in FHA-VA and private lending procedure and policy. From this beginning, he said, the two groups will work to bring about improvement in circuiting and wiring devices.

The institute director said that it is important that all segments of the electrical industry have a much better understanding of the basic problem.

Who's This Man Edison?

The Russians, it seems, got a seven-year jump on Light's Diamond Jubilee. Radio Moscow announced last week that a Russian engineer, Alexander Lodygin, invented the incandescent lamp in 1872.

RECENT AERIAL VIEW accents concrete coal silos for first unit. Identical second unit will adjoin to right and use the same stack.

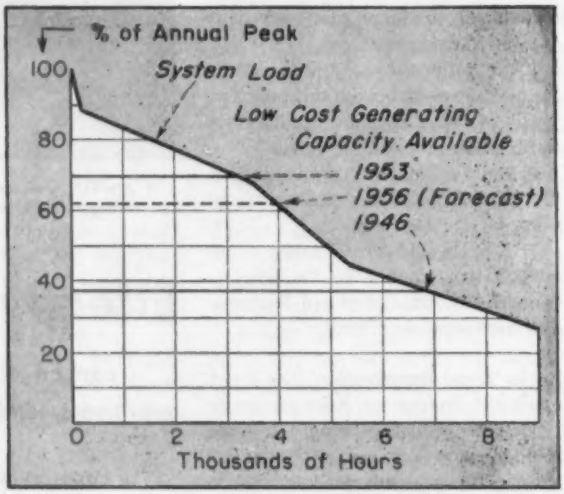
Martins Creek . . .

Pennsylvania Power & Light boosts system capability with economical outdoor plant near concentrated load, designed for operation less than 4,000 hours per year

M. D. ENGLE, Mechanical Engineer,

N. N. SMELOFF,
System Planning Engineer,

S. C. TOWNSEND, Electrical Engineer
Pennsylvania Power & Light Co, Allentown, Pa.



SYSTEM LOAD CURVE shows need for new capacity during heavy loads. Estimate is 3,900 hours in 1956 against 3,200 hours in 1953

Need for new generating capacity in the eastern portion of Pennsylvania Power & Light Co's system to operate only 3,000 to 4,000 hours per year is responsible for many departures from convention in the design of the Martins Creek Steam Electric Station. Fundamental differences for this station are:

1. Bituminous coal will be burned, in spite of its higher delivered price, because the higher cost of anthracite-burning equipment could not be justified.

2. Low cost of construction was more important than higher thermal efficiency because of the low load factor.

3. Duplication of auxiliary supply to guard against plant shut down was held to a minimum.

4. Frequent startup and shutdown and protection against damage during down periods influenced design.

A new steam station planned to operate from the beginning at only 20 to 40% capacity factor is unusual for a system deriving most of its power from fuel. Most systems under similar circumstances design each new unit for efficient base-load operation and carry their peaks on the less-efficient older units.

But PP&L has installed about 400 Mw at Sunbury during the past five years. Fuel there is part small-size anthracite and part bituminous, and the delivered cost of each is appreciably lower than at Martins Creek. Plants of the Scranton area, plus older anthracite-burning capacity near the coal fields, add over 300 Mw. Economical additional capacity is required for heavy load periods totaling less than 4,000 hours per year. Estimates show need for 250 Mw by 1956.

Site Location . . . Service areas of PP&L and its subsidiary, Scranton Electric Co, comprise about 10,000 sq miles in central eastern Pennsylvania. Included is practically all the anthracite mining area. System peak was approximately 1,000 Mw in 1953, but the only cities over 100,000 are Scranton and Allentown. Load in the Allentown area at the eastern fringe of PP&L's system is heavy. And most of the power has been transmitted from Sunbury Station 100 miles west and other plants in the anthracite fields. Need was apparent for a new power source near this load area.

At Martins Creek was found a site offering many advantages. Existing 66-kv transmission nearby had capacity to absorb the first 132.5-Mw unit's output. The second unit will require a 24-mile, 220-kv transmission extension. The Delaware River provides ample cooling water for a large generating station. A natural dam maintains a storage pool, and water discharged below it cannot recirculate. And the 450-acre tract provides ample space for station expansion, switchyards, fuel storage, and ash disposal.

Burns Bituminous Coal . . . Despite the company's favorable experience in other plants burning small size anthracite for economical power production, Martins Creek will burn bituminous coal. Reasons for this departure are:

1. Fuel consumption of existing anthracite-fired plants exceeds the foreseeable supply of steam sizes of anthracite on the system.

2. Investment in additional facilities required to burn anthracite or mixture of bituminous and anthracite cannot be justified.

A Station Built for Low Load Factor

Coal is delivered by rail and unloaded into a 160-ton hopper. A "car shake out" expedites the unloading, assisted by oil-fired, car-thaw pits when conditions require. A belt conveyor moves the coal to bunkers or alternately to the storage area. Coal from storage is reclaimed by bulldozing or carryalls to the same hopper.

Bunkers are concrete silos, two for each generating unit. These are 35 ft in diameter, 75 ft high, and hold 2,400 tons. Two silos hold enough coal to operate their generating unit 40 hours at full load. And 30-in. vertical pipes drop coal from these silos to the coal feeders with minimum stoppages. After pulverizing, coal will burn in 12 horizontal burners per boiler.

Simplicity Cuts Investment . . . Rate of load growth and operating limitations had established 132.5 Mw as the desirable size of unit. Several steam conditions were studied for their effect on overall production cost at 20 to 40% capacity factor. Conclusions were that higher steam pressure and temperature would not result in the lowest overall cost. Because 1,250 psi, 950 F were the lowest steam pressure and temperature for which 132.5-Mw units had been designed, they were selected for these two units. Increased investment for reheat could not be justified for the expected operating conditions.

The 1,200,000-lb-per-hour boilers were selected for continuous output to match the guaranteed turbine throttle flow. Their design drum pressure of 1,500 psi provides adequate range to eliminate need for power control valves. Further savings were achieved by using two parallel "schedule 160" seamless pipe steam lines in place of a single forged line.

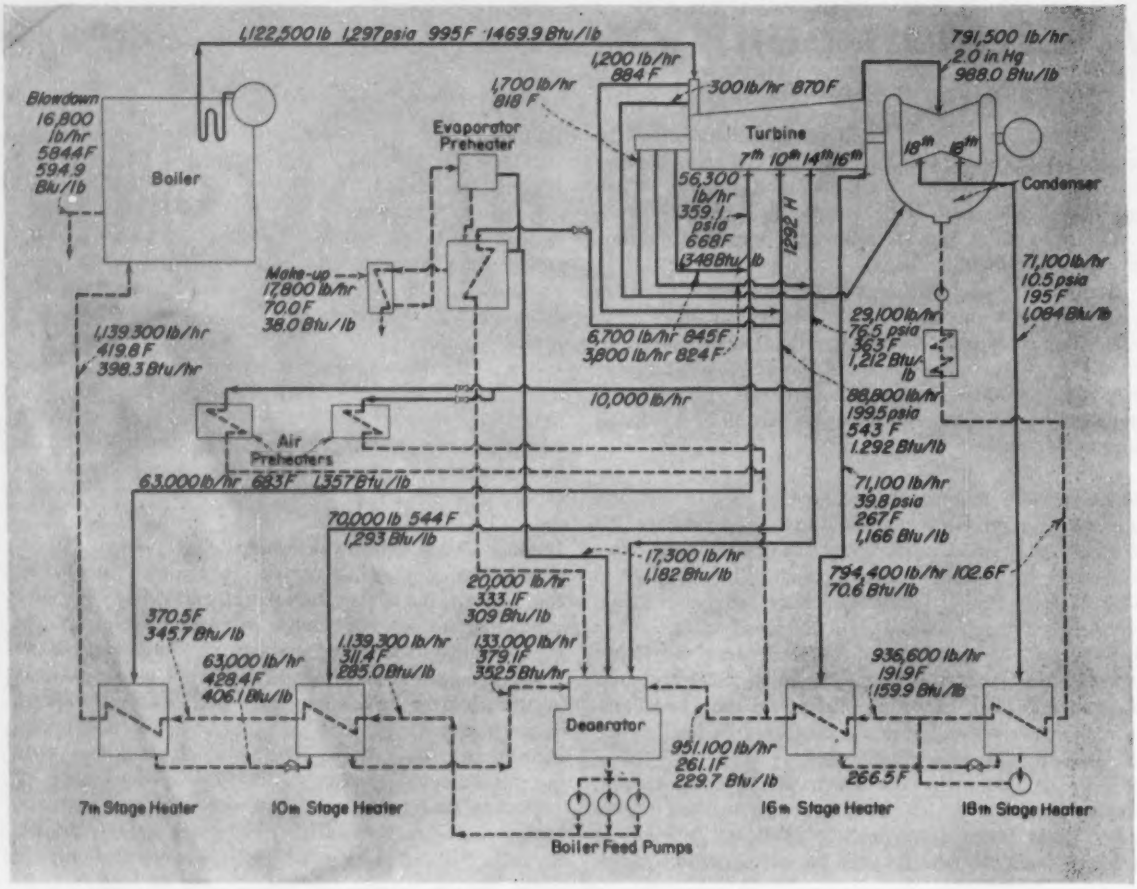
Condenser basement is only 5 ft below grade to save excavation and sub-surface construction costs. Further savings were achieved by using unusually small condensers. Back pressure up to 4 in. Hg for a few hours of full load operation with maximum river water temperature was a special requirement for the turbine builder.

Possibility that changing conditions in the future may make present simplicity costly can be discounted. Unit design permits each new unit to be built for best system economy unencumbered by existing installations. And forecasts show continuing need for economical peak load capacity.

Outdoor Design Reduces Investment . . . Omission of buildings enclosing major generating equipment, auxiliaries, coal bunkers, ducts, fans, breechings, and piping contribute substantial savings. But unlike some outdoor plants, the main condensers, exciters, turbine oil equipment, pulverizers, burners, and many of the pumps are indoors. Housing for them is provided by enclosing the space beneath the turbine operating deck and the coal bunker with concrete block walls. An oil-fired boiler provides heat when the steam generating units are shut down.

Placing feed water regulators ahead of high pressure heaters brought them inside the turbine area enclosure. Extending drain pipes from high pressure heaters and

TRANSMISSION SYSTEM links base load station at Sunbury and anthracite-fired generation in central and northern area to concentrated load around Allentown. Growth there guided choice of Martins Creek for new station location in lieu of transmission reinforcement



Heat Balance Omits Reheat for Low Incremental Cost . . .

evaporators through operating deck of the turbine made it possible to place receivers and controls within the concrete block enclosure.

Walk-in enclosures house the front end of turbines, the boiler drum heads, control room, and coal conveyors. Removable enclosures cover the traveling screens at the water intake, engine-driven emergency generator, and fire, filtered-water, and sump pumps.

Offices, laboratory, meeting room, locker and shower room, shops, stores, and first-aid room are all concentrated in a detached office and service building. This building is also built of concrete block and heated by extracted steam or the oil-fired boiler. Its arrangement permits extension in two directions as required.

Similar construction provides a central control room on the turbine operating deck for major equipment and switchyards. This room is air conditioned.

Enclosed spaces protect operators and other personnel who normally work indoors. Refrigerators and grills for lunches are provided at the principal operating locations. But those who patrol intake screens, forced and induced draft fans, and handle coal or ashes are exposed to the weather.

Spare Equipment Minimized . . . Two vertical circulating water pumps are provided at the intake structure for each condenser. Both will operate normally, but one can handle turbine at full load.

Station service compressed air is supplied by one compressor for each unit. Spare compressor is gasoline-engine driven and portable for use at many locations where permanent piping is uneconomical. This station service air serves as an emergency source for control air.

A single coagulator and filter are provided for conditioning service water. Protection against water system outages is the 250,000-gal standpipe for storing filtered water.

Similar simplicity extends to the 66 and 220-kv switchyards which are interconnected by a 75-Mva TCUL transformer. Each generator connects with 6,000-amp, isolated-phase, metal enclosed leads to its 174,000-kva FOA, 3-phase transformer. These transformers will be shipped assembled and placed directly outside the enclosure beneath the generators for minimum lead length. Transformers are designed so a large caterpillar crane can lift off the tank for internal repairs in place. And the same crane is used to handle racks and screens at the intake, pumps, induced and forced-draft fans, oil circuit breakers, and transformer bushings.

Tapped off each main generator lead is one 10,000/12,500-kva, OA/FA, 3-phase station service transformer.

Station service is a single 4-kv bus for each unit. Bus and its 150-Mva air circuit breakers are metal-enclosed switchgear beneath the turbine operating deck. Motors 200 hp and larger are served directly from this switchgear. Smaller motors are grouped on 480-v load centers in turbine, boiler, and coal crusher areas, respectively, each supplied by a 1,000/1,350-kva dry-type transformer.

Grounding system for the switchyard is welded flat steel bar, galvanized above the ground line. It ties to apparatus, towers and power plant conduits, and building framework. Conductivity of the conduits is assured by tack-welding all joints. Tests indicate resistance below 0.5 ohm, and the overall cost is low.

Frequent Start-up Facilitated . . . Station design provides for shut down each night and quick start in the morning when required by the interconnected system load. Automatic controls, complete instrumentation, and centralized control permit this kind of operation with minimum personnel.

Normal operation of screens and wash pumps at the intake is time-clock controlled with supplementary starting actuated by pressure drop across the screens. Abnormal make-up water required for frequent start-ups is provided by one 40,000-lb-per-hour evaporator for each unit and a 150,000-gal condensate storage standpipe. Water in deaerator storage tanks is sufficient for 10 minutes at maximum boiler output.

Controls for boilers, turbine generators, and auxiliaries are centralized in one control room. Supervisory control of the switchyard is also brought in to the control room. Exceptions are coal handling controlled from the crusher house, ash and dust handling from the pulverizer room, and electrostatic precipitators from separate buildings near the precipitators. Water treating plant controls are located near the equipment. Placing these controls at strategic locations spreads the functions more logically among operating personnel and reduces the cost by a considerable amount.

Protection against freezing during shut down is achieved by placing most vital equipment within enclosed space where heat is provided. Removable enclosures not normally heated are held above freezing by electric heaters. And outdoor pipe lines have heating cables beneath the thermal insulation.

Safety Is Built in . . . Martins Creek Station includes six distinctive provisions for safety to personnel and protection of equipment. These are:

1. Central control room is sealed off from remainder of plant so that fire or smoke will not drive the operators from their posts.

2. Ventilating fans have outside controls for use in case of fire.

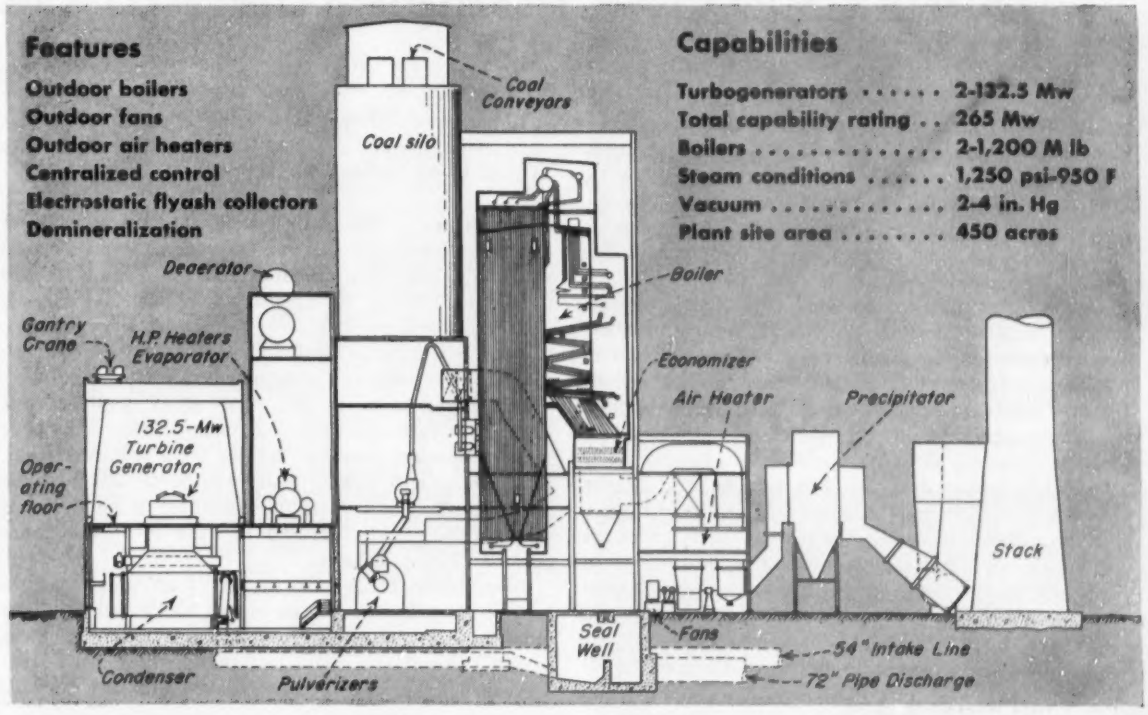
3. Hydrogen in the generators can be vented from outside the condenser basement. Hydrogen and CO_2 bottles are located out of doors.

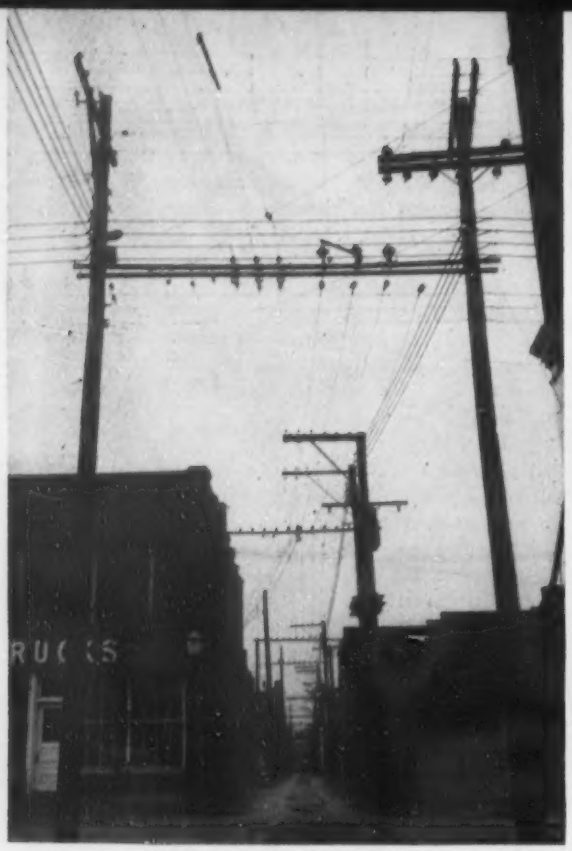
4. Gasoline engine-driven fire pump is outside station enclosures.

5. Gasoline engine-driven sump pump for de-watering turbine basement is outside station enclosures.

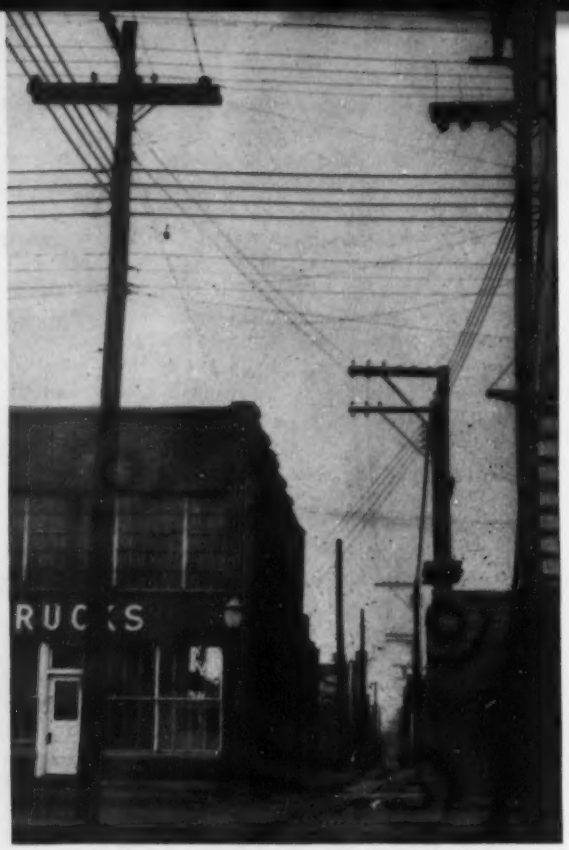
6. Automatic fog nozzles protect oil reservoirs, hydrogen seal units, and the critical area beneath the turbines to minimize damage in case of oil fires.

. . . at Martins Creek Built for Low Load Factor Operation





BEFORE—Alleys were congested with six-wire secondaries and two or more services per customer. Secondaries were on two-pole structures with poles on opposite sides of alley. Rebuilding was necessary



AFTER—Appearance of alleys was improved by installation of four-wire secondaries on vertical racks with poles on one side of alley. Installing but one service per customer further improved appearance

Wapakoneta—1st Small Town to Get

The striking difference in the appearance of distribution facilities in the pictures above was brought about by the desires of Wapakoneta, Ohio, businessmen. When the City's Electric Light Department asked them, "Would you rather have us direct our efforts toward minimum rates or maximum service continuity?" they unanimously chose the latter.

To give the business men what they wanted the department decided to build the first light-duty overhead secondary network in a small town. The population of Wapakoneta is only 6,000. Its business district extends 3½ to 4 blocks on Auglaize Street. Distribution facilities are in two alleys, one on each side of and parallel to the street.

Load was estimated at 600 kva, but the load density was such that there was a transformer on almost every pole. Secondaries in both alleys were 6 wire, 3 wire for single-phase service, and 3 wire for 3-phase service. In this restricted area the transformers supplying single-phase service were 7—50 kva, 3—25 kva, 2—37½ kva, 1—10 kva, and 1—15 kva. Three-phase service was supplied by three banks consisting of 3—7½ kva, 2—10 kva, and 1—37½ kva and 1—25 kva.

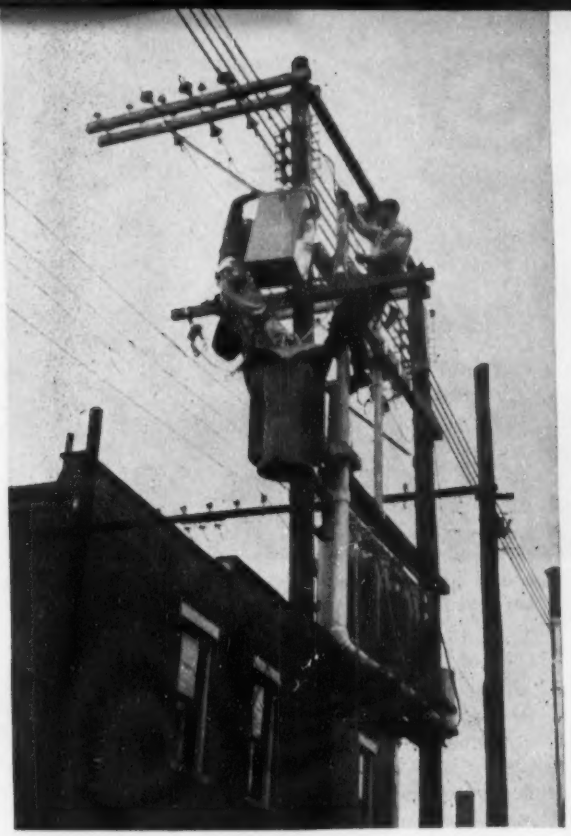
It was predicted that as a result of voltage improvement alone, the 600-kva load would increase to 800 kva as soon as the network is completed.

New System . . . The rebuilt system will have six banks of 3—50-kva transformers each. They will be wye-connected secondaries and delta primaries and will operate on taps to give 125/216 v. Each bank will be tied into the secondary network consisting of 4—250 MCM conductors. Connections to the network will be through the new light-duty, 150-kva overhead secondary network protector.

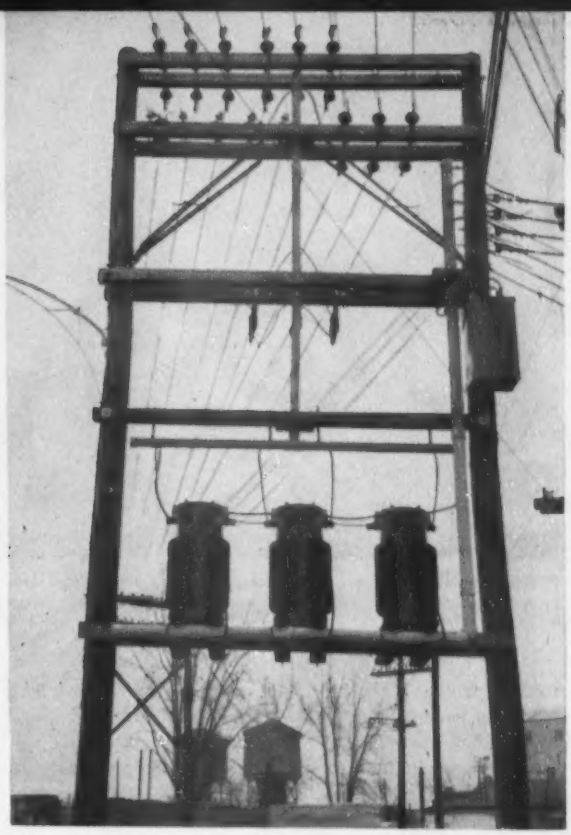
Secondary buses in the two alleys will be tied together at each end of the secondary network. One of these cross-ties is overhead and the other is underground. Single-phase and 3-phase loads will be served from the same secondary bus. A neutral conductor of the same size as the phase conductors will be used to provide more positive clearing of faults.

Transformer banks will be fed from four separate feeders. Two feeders will serve two banks each, and the other feeders will each serve one bank. Three of these feeders also will serve radial load outside the network area.

Availability of two or more feeders near the network



SIX NETWORK BANKS were installed on two-pole structure paralleling alleys. Network protector is being installed on this structure above crossarm. Single transformer was removed when job was finished



TWO-POLE STRUCTURE for three 50-kva transformers and network protector makes a neat installation. Protector is on the pole at right. This view of a completed installation shows how appearance improved

Overhead Network

area, but also serving loads outside that area, is one of the requirements for economical development of the light-duty overhead secondary network. The necessary diversity of loads is provided, and the arrangement fits in with characteristics of the light-duty protector.

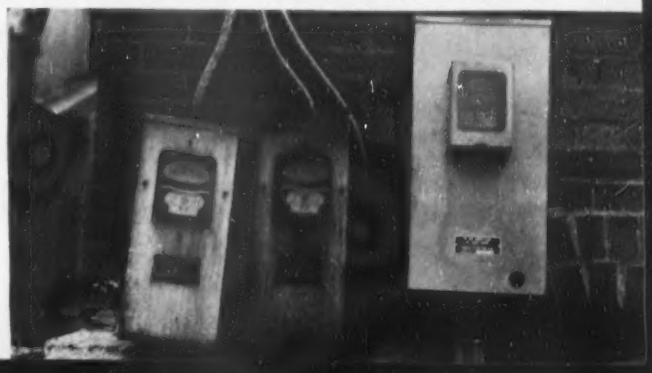
Protector Characteristics . . . Some features of the standard network protector were omitted from the light-duty overhead unit in order to reduce both cost and weight. The light-duty protector does not have main fuses, an operation counter, a position indicator, or a phasing relay. It consists primarily of a 3-pole air circuit breaker with relays and control elements, including a closing mechanism and an ac shunt trip device.

A short circuit on any primary feeder serving the network area will cause all of the protectors on that feeder to open on reverse energy. After the feeder has been repaired, the network protectors on that feeder will automatically reclose when the feeder circuit breaker at the substation is closed.

These protectors have a special desensitizing relay to prevent tripping when the circuit breaker opens at the substation. This prevents opening on a surge on the

LIGHT DUTY overhead network protector of 150-kva capacity is inspected by Eugene Dill, engineer of Wapakoneta Electric Light Dept

FEWER METERS will be required on the new installation. Four-wire meter installation at the right replaces the two meters at the left

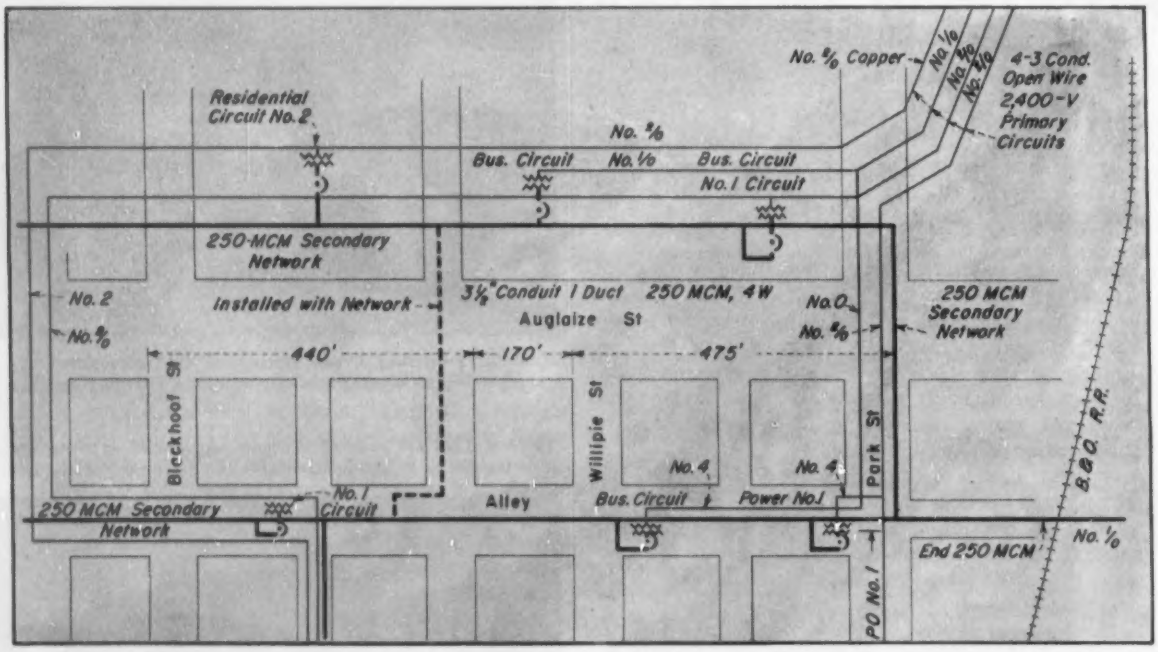


POOR CONDITION of existing system prompted original plans for complete rebuild that led to plans for network. Transformer structures had deteriorated, secondary conductors were too small, and almost every pole carried a transformer. Secondary net was solution

feeder. If the breaker remains open, there will be flow from the network to the radial load on this feeder. Such reverse flow through the protector will cause it to open, as it does when there is a short on the feeder. Because of this characteristic the operation of these protectors cannot be checked by opening the feeder breaker. As the feeder serves radial load in addition to its network load, this method of checking protector operation could not be used anyway.

When the initial studies were made on the rebuild job, banked secondaries with fuses in the secondary mains between transformers were seriously considered. This would have reduced voltage regulation problems and flicker.

But some troubles were anticipated with this type of system, for example, cascading might have happened in case of a transformer failure. Also, it would have been difficult to know when fuses in the secondary bus were blown. These problems plus customers' indicated desire for quality service, which they knew would come at the expense of passing up a rate reduction, tipped the balance in favor of the network. Load and revenue, however, would not support a conventional underground network; so the light-duty overhead network was selected as the ideal solution. The 50-kva transformers were reused.



OVERHEAD SECONDARY NETWORK has six banks of three 50-kva transformers each, supplied by four feeders. Network will extend three blocks. Four-wire secondary runs west of underground (broken line). Circuit will be closed west of Blackhoof when load justifies

Kilovar Output and Voltage Control of Today's Power Stations

C. A WOODROW
H. O. SIMMONS, JR.
Electric Utility Engineering Section, General Electric Co., Schenectady, N. Y.

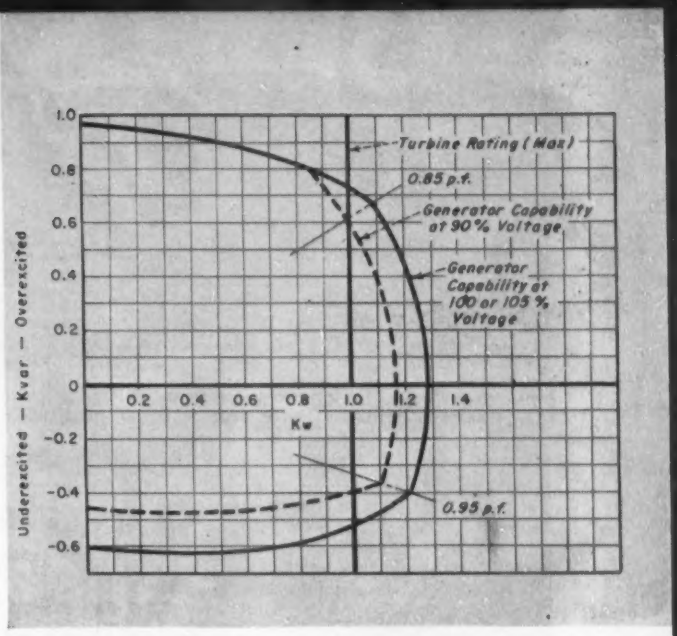


FIG. 1—GENERATOR KW-KVAR CAPABILITY characteristics of new handbook machine. Limits apply only for operation at 30 psi hydrogen at which the rating is 128% of turbine rating

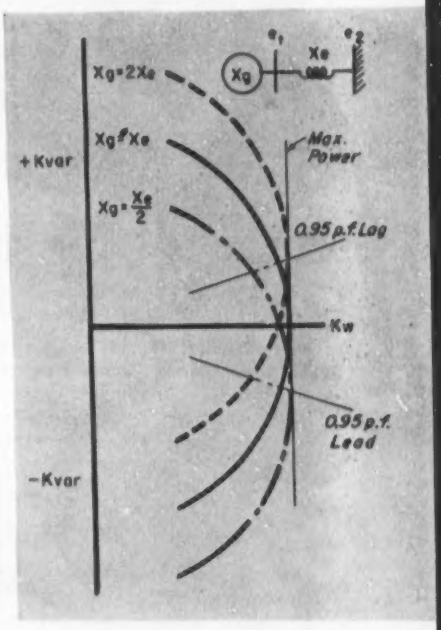


FIG. 2—STABILITY CHARACTERISTICS for constant generator terminal voltage e_t

Back in 1950 it was suggested that the high-power, long-distance hydro-transmission philosophy of no-kilovar transmission could be profitably applied to metropolitan power systems in some instances. At the time it was anticipated that more extensive use of load-area kilovar generation would relieve voltage troubles and thermal bottlenecks.

Since that time load area kvar generation has grown at a tremendous rate. Today certain systems are operating on the philosophy that consumer voltage can be controlled in a satisfactory manner through the use of load area switched capacitors and a moderate scheduled variation in generator voltage. On other systems use of load area kvar generation for voltage control has become increasingly important but not to the extent of a major reduction of investment in load ratio control and substation regulators.

A voltage control problem is always created whenever an attempt is made to push appreciable kvars through electrical distance, i.e. reactance. Ideally this problem largely disappears if load kvars are generated in the load area and the transmission kvar losses are generated at intermediate locations. Switched capacitors or condensers would take care of both kvar variations and voltage control—and the generating station could stick to its primary job of delivering real power at a suitable constant voltage level. However, this ideal concept is seldom completely practical. Actually, available kvar generating capacity is still sometimes so far from the load area—particularly under emergency conditions—that a terrific voltage problem results from the attempt to make those kvars available where and when they are needed.

It is not the intention here to analyze the pros and cons of switched capacitors vs load ratio control, substation induction regulators, etc. It is rather to evaluate certain aspects of the use of the generating station to supply both kvar load and adequate consumer voltage. An attempt is made to develop crude criteria which indicate, in relatively simple system terms, the variations which can reasonably be expected of the generating station.

Clean Cut Limits . . . Consider first, two extreme limits:

1. Distribution Direct from the Generator Bus . . . About the most extreme case one can imagine involves a high density secondary network fed by 13-kv cables served directly from the generating bus of a nearby, firm-power generating station that has ample kvar capacity. Here, the generating station can readily take care of voltage control—with perhaps ±2% generator voltage variation. All load kvars can readily be supplied from the generating station. However, even under this extreme condition it must be recognized that secondary network capacitors can sometimes be justified.

2. Long Distance Transmission Inserted Between Generating Station and Load . . . On the other extreme, probably the most important concept is: Reactive power, kilovars, cost so little to generate and so much to transmit that no one can afford to transmit them any great distance.

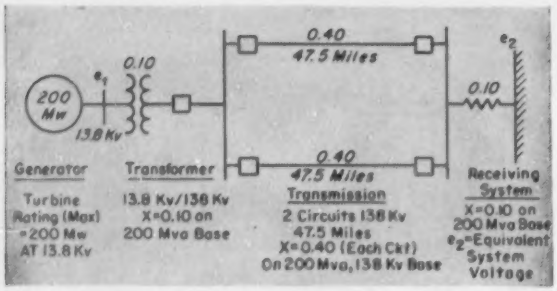


FIG 3—FOR 0.4-0.6 SYSTEM external reactance of 40% jumps to 60% when one transmission line is switched out of circuit above

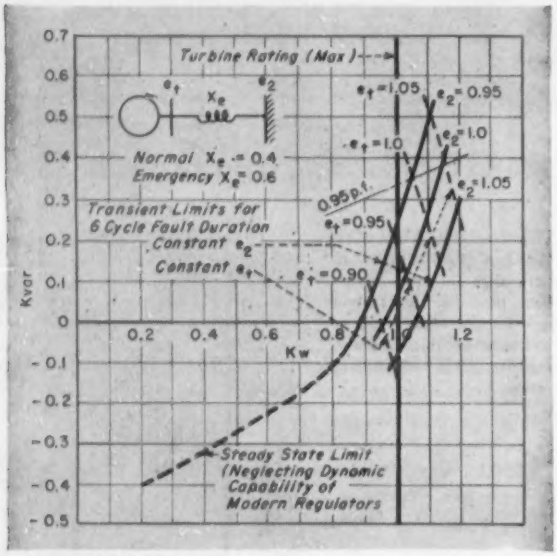


FIG 4—STABILITY LIMITS for 0.4-0.6 system. Generator voltage regulators are assumed. Resistance and charging current are neglected

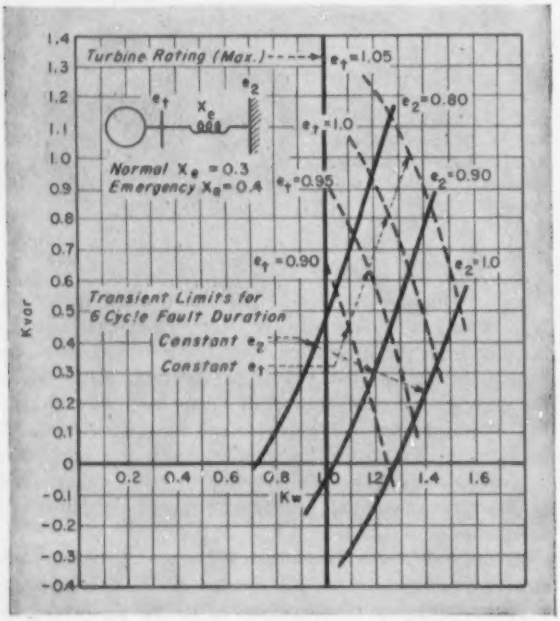


FIG 5—STABILITY LIMITS for a 0.3-0.4 system which corresponds generally with characteristics of a metropolitan bulk power system

Evaluation of Place of the

The generating station may generate some kvars—not for transmission to the load area—but to supply some of the transmission kvar losses. Transmission economy demands high line loading and receiving system kvar generation both to hold up the transmission voltage and to supply the load area kvars.

Operation at the generating station can be relatively simple in this case. It involves holding source voltage constant by generator voltage regulators which can also automatically provide sufficient kvar generation to supply a reasonable portion of the transmission kvar losses.

The General Case . . . The general case falls somewhere in between these limits. Today we seldom find new installations with distribution direct from the generator bus. Even for very short distances the customary double transformation of voltage—up to transmission and down to the load area—involves an additional reactance and kvar loss which, at full load, can readily be 20% of the power transmitted.

This transmission kvar loss and the load area kvars can be supplied from the generating station if load ratio control is used at the step-down transforming station. However, the alternative must not overlook adding sufficient load area kvar generation to eliminate the necessity for load ratio control on most of the step-down transformers and to reduce the transformer kva loading.

With regard to the general case six significant points will be discussed in this article. They are summarized as follows:

1. There appears to be a definite trend towards more electrical distance (percent reactance) between new generators and the external system served.

2. A wide variation in kvar output at the generating station is available if it can be used. At least 10% generator voltage variation should create no dangerous internal limitations.

3. The prevailing, instinctive fear of low kvar output from the generating station is not necessarily justified.

4. In the metropolitan systems it is usually perfectly safe from a system stability standpoint to reduce generator voltage by 10% and the "equivalent system" voltage by 5% during light system load conditions.

5. With 10% generator voltage variation, the usable, normal generator kvar range diminishes rapidly as electrical distance (reactance) is increased. That usable kvar range is cut nearly in half if the "equivalent system" voltage is to be dropped 5% during light system load conditions.

6. For the longer electrical distances, emergency voltage conditions can be markedly improved by adopting the practice of low normal generating station kvar output. Under these conditions, however, the generator voltage regulator serves an extremely important function.

1. Per Cent Reactance as a Measure of Electrical Distance . . . In many cases new generating stations must be installed at some distance from the existing system. Here, generating station performance can quite accurately be analyzed in terms of system voltage behind the "equivalent system" per cent reactance based on generating station

full load output. In other cases the bulk power system is such a complicated network that "equivalent system" concepts must be used with caution—and always checked by ac board analysis.

This per cent external system reactance is a significant measure of electrical distance—particularly from the standpoint of generating station kvar output and voltage control. There also appears to be a definite trend towards an increase in this electrical distance, despite the growing use of higher voltage. Important contributing factors are these:

- New plant sites today are moving further away from the load area served.
- Even when new stations can be located in the load area, power is often transformed twice, up to a high voltage bus and down through transforming stations. This double transformation is equivalent in electrical distance to 75 or 100 miles of overhead transmission.
- Transmission economics demand both heavier loads per circuit and bigger conductors. Based on that higher loading, each circuit unavoidably must have a higher per cent reactance.

2. Generating Station Capabilities and Limitations . . . Fig 1 shows the kw-kvar capabilities of new handbook generators. At 30 psi hydrogen they have a kva rating which is 128%* of maximum turbine rating. While these characteristics are fairly well recognized for the rated voltage condition, the indicated limits for 90% voltage must be treated as rough approximations. They are developed from the concept that conservative planning should call for no more than rated armature or rated field current at any voltage.

It will be noted that a limiting stator-end-iron heating condition results at about 0.95 pf lead. Operation further into the under-excited region requires an appreciable reduction in armature current (Fig 1). Older generators (with magnetic core clamping fingers, etc) cannot safely be operated at 0.95 pf lead at full kw output. Under system light load conditions, however, these old less efficient units, if on the line, will normally be called on to carry only partial kw output.

Many users today avoid leading pf operation of generators as if it were a deadly plague. However, a few have found that future high tension cable capacitance will call for such operation and have found no danger in it. That, however, is a system and not a generator problem. As Fig 1 indicates, the new standard generator is capable of a wide variation in kvar output at maximum turbine rating—all the way from +70% kvars at 100 or 105% voltage down to −40% at 90% voltage.

Normal practice calls for the supply of the auxiliary system directly from the generator. Generator voltage variations must, therefore, be passed along to the essential auxiliaries. This should cause no difficulty if no more than 10% generator voltage variation is planned. However, if generator voltage is to be varied all the way from 90 to 105%, auxiliary system requirements must be given careful consideration. Often, for example, the boiler feed-pump motors represent a limiting requirement. With auxiliary transformers of normal reactance and a 15% generator voltage variation, careful selection of auxiliary transformer turn ratio is required to insure the 80% voltage which is generally for adequate torque margin during the start of these big motors.

Load ratio control could, of course, be incorporated in the auxiliary transformer to shrink the auxiliary voltage variation. So far as is known, this solution for the main auxiliary transformer has been found unnecessary.

3. Does Reduction in Generator Kvar Output Reduce Stability Margin . . . Instinctive reaction is: "If we reduce generator excitation, we reduce the safe power limit." This is true for a single machine tied to a very stiff bus. But it does not necessarily apply to a generating station with its actual "equivalent system" reactance.

Curve $X_s = X_s$ of Fig 2 roughly represents a generator feeding all its power to a synchronous motor of the same size. In this case, e_s is the motor excitation and X_s the motor reactance. Maximum power results as shown from unity power factor operation of both generator and motor.

Curve $X_s = X_s/2$ illustrates pull out characteristics of conditions which can and have occurred: a 25-cycle generator feeding both 25-cycle load and a 25/60 cycle frequency changer of half the generator size. In this case whenever the 25-cycle load is low, the major output of the 25-cycle turbine must go through the frequency changer. A steady state stability problem exists because the available power is nearly twice the frequency changer set rating. As indicated—so long as generator terminal voltage is held constant—maximum power is attained by increasing the excitation of the weak machine, the motor, and decreasing the generator excitation to about 0.95 power factor underexcited.

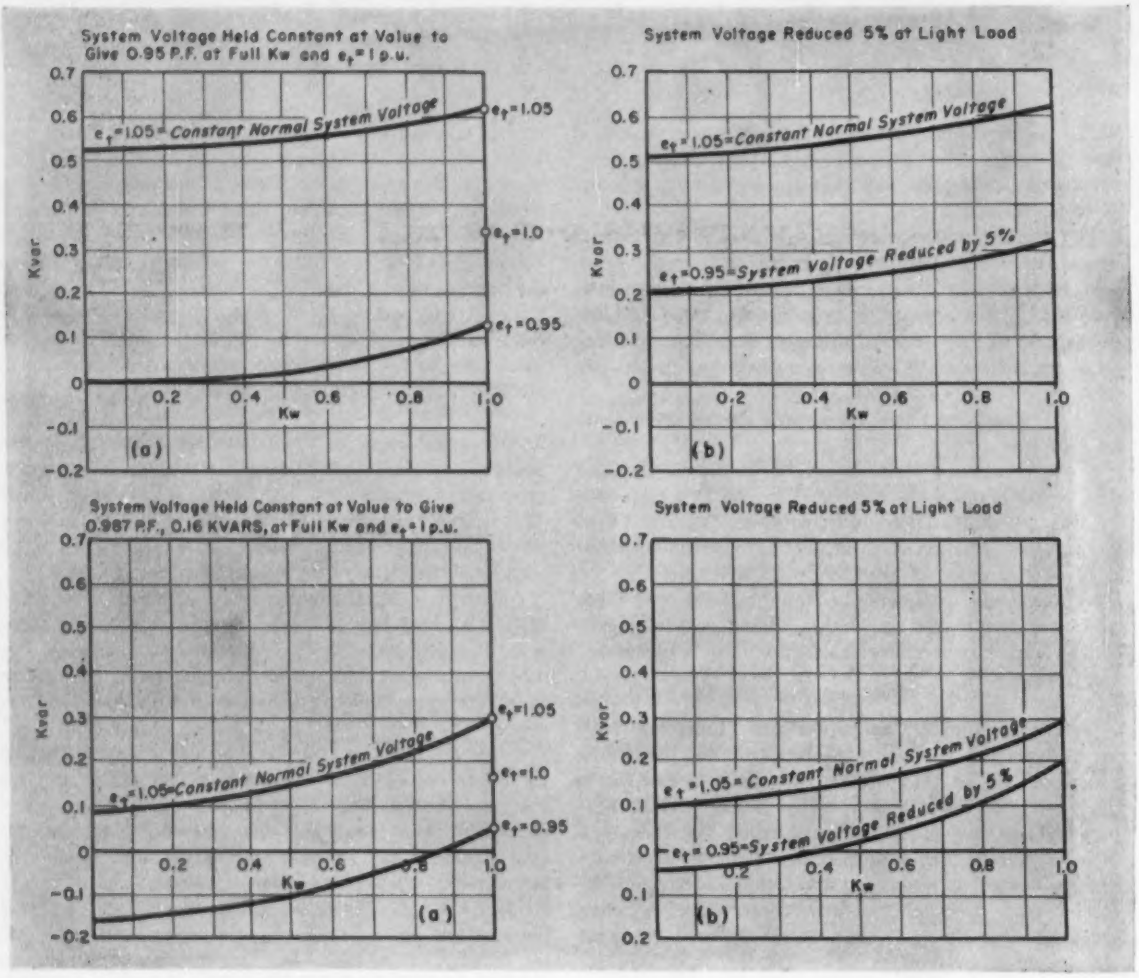
Admittedly, however, the usual external system reactance, X_s, is appreciably less than the generator synchronous reactance—and the curve, $X_s = 2\,X_s$, is typical at least under hand control of excitation. Maximum steady state power results from higher generator excitation and overexcited pf operation.

A new concept has recently become important; i.e., in effect, the dynamic capability of modern voltage regulators very appreciably reduces the effective synchronous reactance of generators. Actual steady state performance in this case may well become that of the curve, $X_s = X_s$, with higher pull out at unity power factor than at higher excitation.

Fig 2 is used to illustrate a principle rather than to evaluate power limits. Actually, steady state stability limits with modern voltage regulators are so great that it is seriously proposed to reduce markedly generator short circuit ratio.

Broadly, the curve, $X_s = X_s/2$, can be used to illustrate why the shape of the kw-kvar characteristics for transient stability are often decidedly in favor of lower generator excitation if system voltage, e_s, can be raised to maintain generator terminal voltage at its normal value.

* Footnote: AIEE-ASME Preferred Standards have about 5% greater capability at 30 psi.


System Voltage Held Constant at Value to Give 0.95 P.F. at Full Kw and e_t = 1 p.u.
System Voltage Reduced 5% at Light Load
e_t=1.05=Constant Normal System Voltage
e_t=1.05
e_t=1.0
e_t=0.95
e_t=0.95=System Voltage Reduced by 5%
Kvar
Kw
(a)
(b)
System Voltage Held Constant at Value to Give 0.987 P.F., 0.16 KVARS, at Full Kw and e_t = 1 p.u.
System Voltage Reduced 5% at Light Load

FIGS 6 AND 7—USABLE KW-KVAR RANGE for a ±5% generator voltage variation on a 20% (above) and a 40% (below) reactance system

Generator transient reactance is only a small fraction of generator synchronous reactance and is almost always appreciably less than the external system reactance, X_e. Therefore, as this curve indicates, we gain a transient stability margin whenever we can increase system voltage, hold the generator terminal voltage constant, and decrease the generator excitation to a value considerably less than unity power factor excitation.

Rather extreme system conditions are represented in Fig 3. This is a 0.4-0.6 system; i.e., normal external reactance is 40%. But when one circuit is switched out, the external reactance jumps to 60%. A transient stability analysis of such a system (neglecting the minor but variable influence of resistance, charging current, and other complications which broadly cancel out) is shown on Fig 4. With rated terminal voltage, $e_t = 1.0$, and 0.95 "equivalent system" voltage, e_s, the maximum safe power is 1.05 times turbine rating. This occurs at 0.35 per unit kvar output. However, if terminal voltage is reduced to 0.96 per unit, this 5% stability margin disappears at a kvar generation a little under 0.25 per unit. When kvar generation is reduced by reducing generator terminal voltage, holding e_s constant, the stability limits decrease.

The situation, however, is entirely different if we change our system design by raising the system voltage, e_s, to transfer kvar generation from the generating station out to the receiving system bus. As the dashed curves indicate, stability margins now increase as the generating station kilovars decrease. It will be noted that this specific evaluation confirms the generalization of Fig 2, $X_e = X_e/2$.

Obviously, therefore, a reduction in the general level of generating station kvar output is not necessarily dangerous; it can add an appreciable safety margin.

At this point a note of warning may be in order. On established systems it is not always easy to raise per unit voltage, e_s. Take, for example, the system of Fig 3. Assume that it is desired to raise the receiving system high tension voltage from 132 to 138 kv in order to transfer kvar generation from the generator to the receiving system. If that 132-kv system is extensive, then it may be difficult to raise voltage. On the other hand if the indicated 10% receiving system reactance is primarily that of several step down transformer banks, then it should be easy to change taps and raise per unit voltage without disturbing the general voltage level of the lower voltage, receiving system.

4. Dangers of Reducing Both Generator and Equivalent System Voltage During Light Load . . . It may be entirely practical to raise the general level of the per unit system voltage, e_s. But the situation is different if we are concerned with the struggle to hold up the consumer voltage at full load and to hold it down at light load. Here it is desirable to reduce both generator and "equivalent system" voltage during light load conditions. This would not be safe on the 0.4-0.6 system (Fig 4) unless system voltage is raised under normal system full load conditions to what may be an unrealistically high value—if the turbine is expected to operate at or near its maximum rating under system light load conditions. If an equivalent system voltage considerably higher than 1.0 per unit is practical at full system load and it is desired to reduce that equivalent system voltage to unity under light system load conditions, then it is not safe to reduce generator voltage below 93% at turbine rating.

Even where distance is not great, conditions as severe as this 0.4-0.6 system can occasionally occur. However, metropolitan bulk power systems are generally no more severe than the 0.3-0.4 system of Fig 5. Here there is no transient stability problem, even with an e_s as low as 0.80 per unit, until generator e_t is reduced to less than 90%. Obviously there is plenty of margin to reduce generator voltage by 10% and system voltage by 5% during light system load conditions.

5. Usable Generator Kvar Range Under Normal Conditions . . . Fig 6a indicates that the available wide variation in kvar output of the generating station can readily be used on low reactance systems. It shows the usable kw-kvar characteristics for plus or minus 5% generator voltage variation for an external system reactance of 20% and a system voltage held constant at that value required to give 95% power factor (0.33 kvars) at rated generator voltage and full turbine output.

Fig 6b illustrates how these kw-kvar characteristics shrink if system voltage is to be reduced by 5% at light load. However, even in this case the generating station can be of considerable help in caring for variations in system kilovar load. Take for example a fairly modern generating station where the significant minimum kw load is 50% of installed capacity. In this case kvar output can be varied from 0.62 per unit kvars at full load down to 0.25 per unit kvars under light load conditions. Admittedly, another station may require a lower kvar output at light load, but it will rarely require as much as 0.6 kvar output at full load; i.e., the average level of kvar output at the generating station is reduced by raising the system voltage level and system kvar generation.

On high reactance systems, the situation is considerably different. Kw-kvar characteristics for an external reactance of 40% are illustrated on Figs 7a and 7b. Here, however, in the interest of adequate stability margin and transmission economy, the normal level of kvar generation is cut to half that of Fig 6; i.e., 0.16 per unit kvars at full kw and rated generator voltage. It will be noted that with constant system voltage (Fig 7a), the usable kvar range is materially less than in Fig 6a. In this case, even with 105% generator voltage, the full load kvar generator output is only 0.30 per unit kvars. In terms of delivered kvars, however, it must be remembered that this 40% reactance system has about .40 per unit kvar loss in I^2X. If transmission kvar generation (from capacitance) is about .10 per unit kvars, the delivered power is at unity power factor at full load. If an attempt is made to reduce system voltage 5% at light load (Fig 7b), provisions must be made out in the system to take care of all the system kvar variations as well as the peak kvar load.

It is apparent that as the electrical distance between generator and load gets greater, it becomes increasingly difficult to transmit kvars and the usable kvar range shrinks

(Continued on page 204)

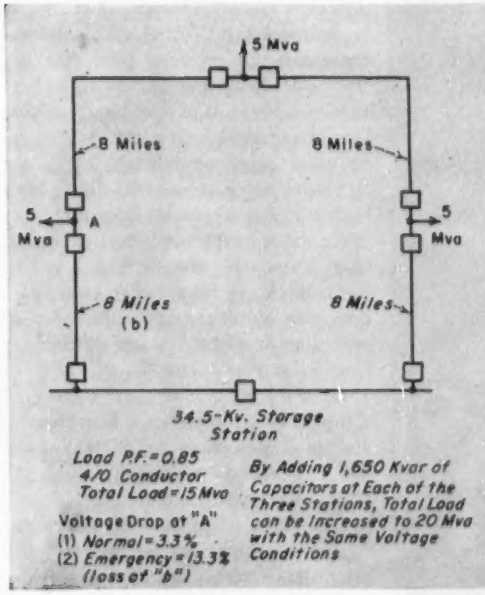


FIG 8—TYPICAL 34.5-KV LOOP subtransmission system, 32 miles in length, with 15,000-kva total load

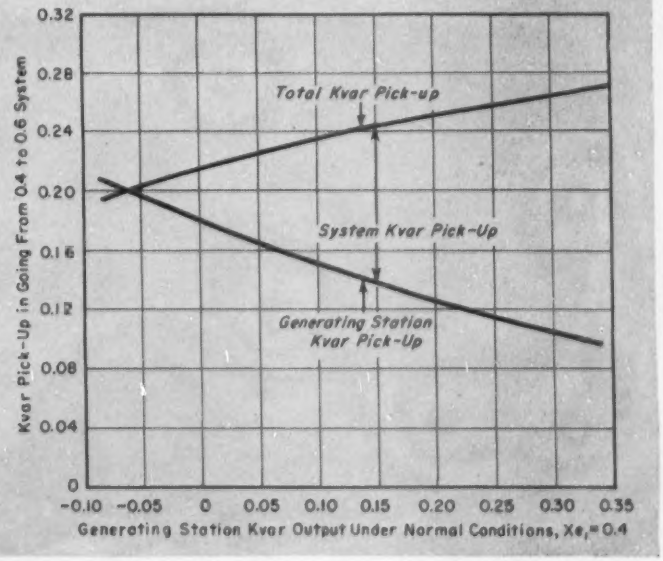
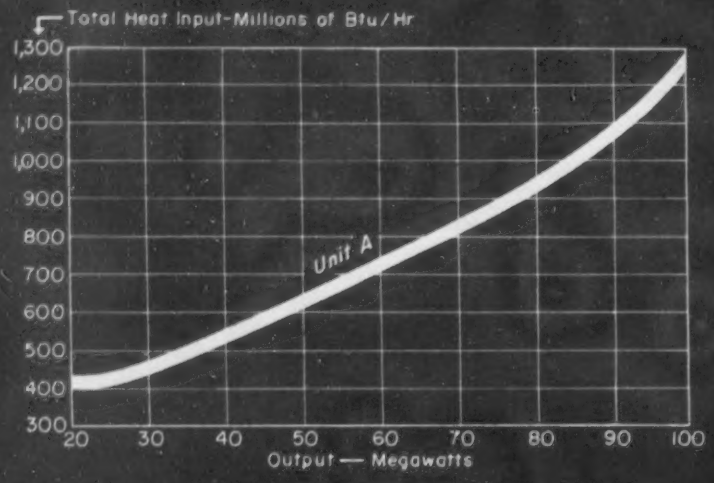
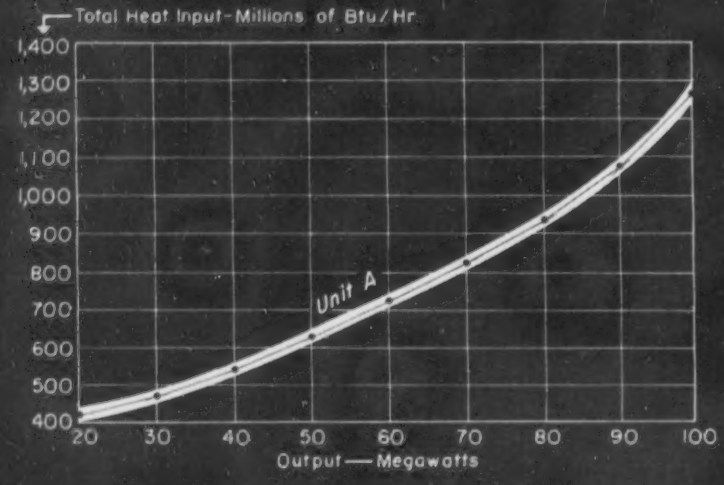


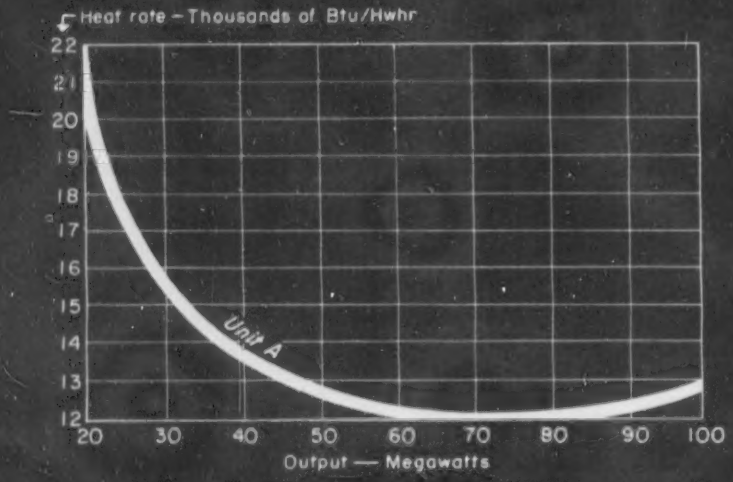
FIG 9—INCREASE IN KVAR REQUIREMENTS under emergency conditions as a function of normal kvar generation at maximum turbine rating for 0.4-0.6 system



1 HEAT INPUT-OUTPUT CURVE, as the first step, is developed from the data given in table. It relates heat input in millions of Btu/hr to Unit A's output given in megawatts



2 SIMPLIFICATION of the heat input-output curve for Unit A substitutes a series of straight lines that join the points for load at intervals of 10,000 kw (10 megawatts)



3 HEAT RATE is plotted to demonstrate the effect of additional load on the efficiency of Unit A. The heat rate given in Btu/kwhr is plotted against the output in megawatts

Incremental

R. T. PURDY, General Superintendent of Power Supply Commonwealth Edison Co, Chicago, Ill.

How much extra fuel (money) must be fed to the boilers to obtain an additional kilowatt hour from the generator? This is the basic problem of incremental loading. The solution of this problem in terms of simple arithmetic has been taught to the operating personnel of the Commonwealth Edison Co, Chicago, and can be taught to the operating employees of any system. But first they must be shown what can be accomplished and how to do it.

The explanation begins with the simplest example involving two units of hardly appreciably different efficiencies. The input-output curve for Unit A is plotted in Fig 1 from data in the table. This input-output curve is simplified by changing from the curve to a series of straight lines joining the points for loads at 10,000-kw intervals as in Fig 2. Valve points on a turbine seldom come at these exact intervals, but the assumption that they do simplifies both the mathematics and the explanation.

Grade School Math Suffices . . . Using simple arithmetic, the curve showing the Btu per kwhr for the different machine ratings of Unit A is developed in Fig 3. This curve represents the average heat rate of the unit. With the curves in either Fig 2 or Fig 3, it is possible to calculate incremental heat rates of Unit A by using simple arithmetic.

The object is to calculate the combination of machine loadings that will allow the lowest overall fuel expenditure. Thus, the curves of Figs 2 and 3 for Unit A are replotted in combination with corresponding curves for a generator of slightly poorer efficiency, Unit B, in Figs 4 and 5.

Explain by Example . . . When each machine is loaded to 80,000 kw, Unit A expends 12,000 and Unit B 13,400 Btu/kwhr, as determined from Fig 4. Then, when the load increases 10,000 kw, there is the problem of determining which machine can take the increase at the least overall input. As Unit A is producing at 12,000 and

Loading Made Simple for Operators

Unit B at 13,400 Btu/kwhr, apparently Unit A should take the addition load. A little arithmetic shows this is not the case.

Unit A consumes 12,000 x 80,000, or 960,000,000 Btu/hr. When its load is increased to 90,000 kw, its consumption is 12,300 x 90,000, or 1,107,000,000 Btu/hr. This is an increase of 147,000,000 Btu/hr. For an increase of 10,000 kw, each additional kilowatt uses 147,000,000 divided by 10,000, or 14,700 Btu/hr.

Unit B at 80,000 kw consumes 13,400 x 80,000, or 1,072,000,000 Btu/hr. When its load is increased to 90,000 kw, it consumes 13,150 x 90,000, or 1,183,500,000 Btu/hr. This is an increase of 111,500,000 Btu/hr, each additional kilowatt using up 111,500,000 divided by 10,000, or only 11,150 Btu/hr.

Operators Soon Understand . . . This simple arithmetic disposes of the first conclusion. If Unit A took up the extra load, each additional kilowatt hour would use 14,700 Btu. By placing the additional load on Unit B, each additional kilowatt hour uses only 11,150 Btu. Despite its higher Btu/kwhr rate, Unit B accepts the new load more cheaply. Once operators understand this, they can be told they have determined the incremental heat rate on each machine for the 80,000-90,000 kw range.

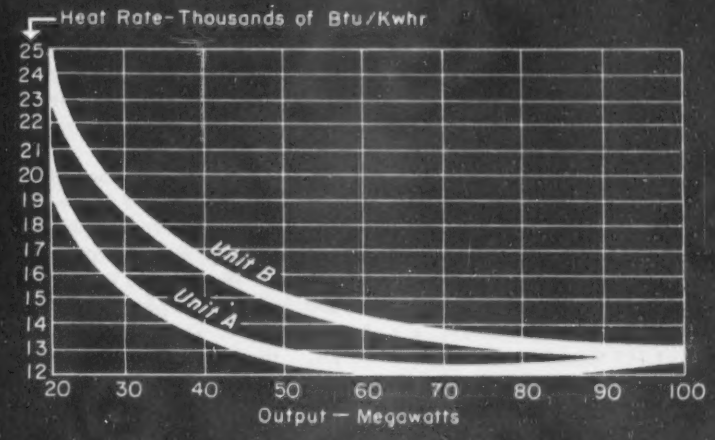
Why Use Incremental Rates . . . Operators may ask: How can Unit B operating at 13,400 Btu/kwhr produce a kilowatt-hour cheaper than Unit A operating at 12,000 Btu/kwhr? It can't. It can only produce an additional or incremental kilowatt-hour for less fuel. Unit A operating at 80,000 kw consumed 12,000 Btu/hr for every kilowatt from 0 to 80,000. After the load was increased to 90,000, it consumed 12,300 Btu/hr for every kilowatt from 0 to 90,000.

Herein lies the reason for using incremental heat rates when loading units or stations. If the increase in consumption per kilowatt hour applied only to the additional 10,000 kw, Unit A would be the more economical machine. The increased rate of consumption, however, applies not only to the additional 10,000 kw, but to each of the 80,000 kw produced previously for 12,000 Btu/kwhr but now costing 12,300 Btu/kwhr.

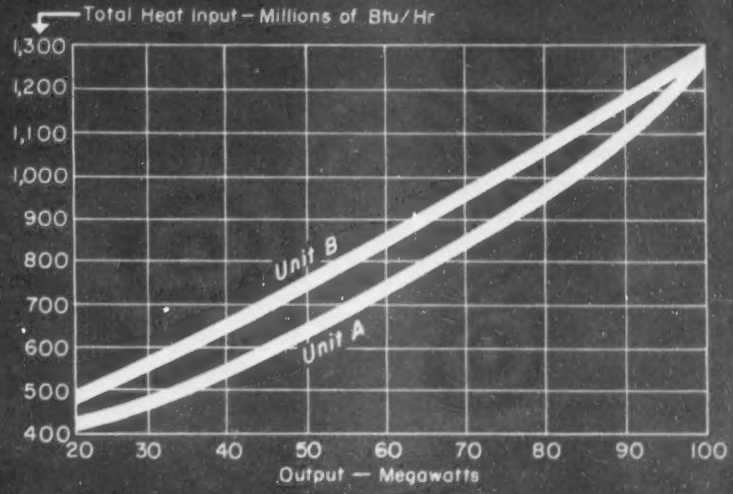
The shape of Unit A's average heat rate curve is such that at 80,000 kw an increase of 10,000 kw in output makes each of 90,000 kw use more input. Thus, each additional 10,000 kw is expensive at 14,700 Btu/hr.

Conversely, when Unit B's load was increased from 80,000 at 13,400 Btu/kwhr to 90,000 kw at 13,150 Btu/kwhr, the additional 10,000 kw came at an expenditure in fuel lower than the previous 80,000 kw. The unit outlay of the previous 80,000 kw was also reduced. Thus, the new 10,000 kw was produced at a lower fuel consumption, actually at 11,150 Btu/kwhr.

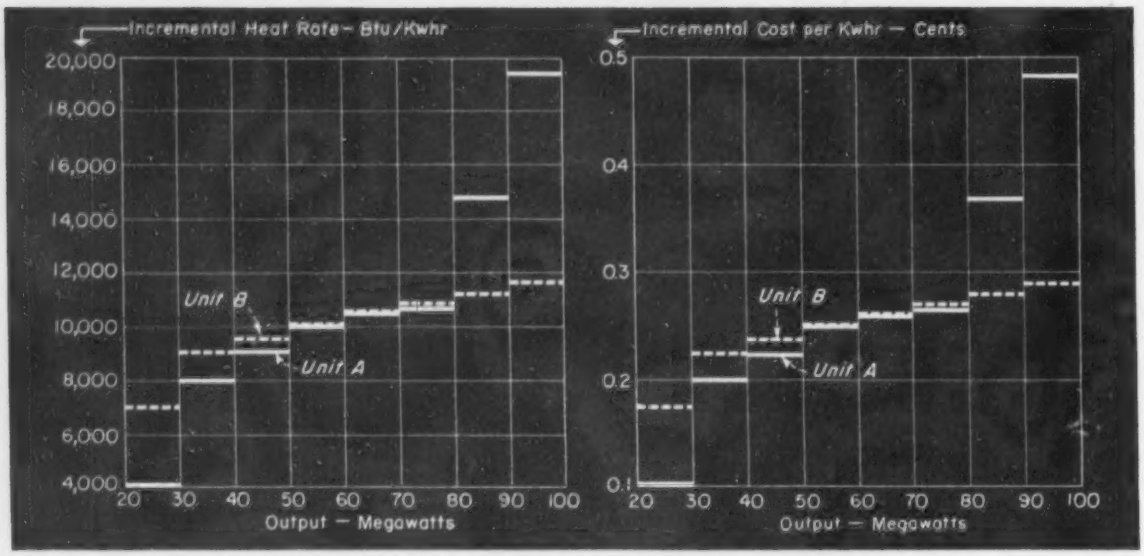
General Observations . . . Fuel consumption for extra load may be more, less, or equal to the average heat rate at the load the unit was carrying. But when an average heat rate curve has



4 GRAPHIC COMPARISON of the heat rate for both units, A and B, is made by transferring the curve for Unit A in Fig 3 and plotting a similar curve for Unit B from table



5 INPUT-OUTPUT values for both Unit A and Unit B are plotted on a single chart which, like Fig 1, shows heat input in millions of Btu/hr and generator output in megawatts



6 INCREMENTAL HEAT RATES for both Unit A and Unit B are plotted in steps as a further way of graphic simplification

7 ECONOMICAL LOADING steps are set-up by giving Btu/kwhr in Fig 6 in cents/kwhr for $5 coal of 10,000 Btu/lb

a characteristic such as Unit A's, that is, has an upward curve near its end as shown in Fig 4, the incremental heat rate beyond the point of the upward turn becomes poorer.

The incremental heat rates of these machines may also be calculated by using the original input-output curves. Using again the 80,000-90,000 kw range, Unit B consumed 1,072,000,000 Btu/hr at 80,000 kw, Fig 5, and 1,183,500,000 Btu/hr at 90,000 kw. The load increase or increment is 90,000 minus 80,000 or 10,000 kw, and the increase in fuel consumption is 1,183,500,000 minus 1,072,000,000, or 111,500,000 Btu/hr. Thus, the additional 10,000 kw consumes 111,500,000 Btu/hr, or 11,150 Btu/kwhr. As expected, this last figure is precisely that obtained from Fig 4.

Explanation Further Simplified . . . To simplify further for operating personnel the explanation of incremental loading, the incremental heat rates for Units A and B are determined for each 10,000-kw step and plotted on Fig 6. From this, it is easy to select the unit that should be assigned any additional load step.

Fig 7 converts Btu/kwhr to cents per kilowatt hour. This measure is more readily understood by operating men. When cost per kilowatt hour is the basis of caluculation, fuel costs at different stations or units using different fuels can be introduced, and the most economical loading of units can be determined.

Operating men can then be taken through the process of loading machines on the most economical basis, starting from scratch. It is assumed that the system is shut down or has never started, both units are ready to roll, and a 20,000-kw load is waiting to be picked up. Fig 3 indicates Unit A should be started. Another unit is brought on the line to protect against the loss of Unit A. Once the second unit is on the line, incremental heat rates govern the distribution of load between machines.

Fig 7 shows that Unit A should be loaded to 30,000 kw, then Unit B to 30,000 kw. Successively then, A is loaded to 40,000, B to 40,000, A to 50,000, B to 50,000. Then units A and B are both loaded to 60,000 and to 70,000. Then successively, A and B go to 80,000. At this point the units shift relative positions on the incremental cost chart, and Unit B is loaded to 90,000 and to 100,000 kw before Unit A is brought up to 90,000 and 100,000 kw. As system load declines, the machine loads should be reduced in the reverse order.

Operating Men Understand . . . When they have followed this explanation, operating men appreciate the advisability of using incremental heat rates in loading units and stations.

Efficiency and Incremental Rate Data for Hypothetical Units

	UNIT A			UNIT B		
KW	Total Btu/hr	Heat Rate Btu/kwhr	Incremental Rate Btu/kwhr	Total Btu/hr	Heat Rate Btu/kwhr	Incremental Rate Btu/kwhr
20,000	440,000,000	22,000		505,000,000	25,250	
			4,000			7,000
30,000	480,000,000	16,000		575,000,000	19,167	
			8,000			9,000
40,000	560,000,000	14,000		665,000,000	16,625	
			9,000			9,500
50,000	650,000,000	13,000		760,000,000	15,200	
			10,000			10,000
60,000	750,000,000	12,500		860,000,000	14,333	
			10,400			10,400
70,000	854,000,000	12,200		964,000,000	13,771	
			10,600			10,800
80,000	960,000,000	12,000		1,072,000,000	13,400	
			14,700			11,150
90,000	1,107,000,000	12,300		1,183,500,000	13,150	
			19,300			11,650
100,000	1,300,000,000	13,000		1,300,000,000	13,000	

New Capacitor Switching Cuts Outlay

Voltage divider method for capacitor banks used by Georgia Power Co employs circuit breakers instead of oil switches for voltages from 23 to 230 kv

H. H. STROZIER, Engineer, Georgia Power Co, Atlanta, Ga.

B. H. SCHULTZ, Product Section Engineer, Line Material Co, Milwaukee, Wis.

Economical switching of multi-step, high voltage capacitor banks above 15 kv has been made possible by a new concept in capacitor switching. This concept, called the voltage divider switching method, utilitzes low-cost, 15-kv oil switches to switch all but the first step of multi-step capacitor banks of any voltage from 23 up to 230 kv.

Previous practice required the use of a circuit breaker for each step of a bank. As the steps had to be kept small enough so that the sudden voltage change produced would be aeceptable to the customers on the system, the cost of the switchgear was often a prohibitive factor in the application of multi-step banks. The new method of switching will save for each step about two thirds of the price of the circuit breaker replaced.

Basic Operation . . . A diagram of the method is shown in Fig. 3. High voltage capacitor banks are constructed in series-parallel combinations using distribution voltage capacitors. The voltage of the system determines the number of series groups, and the size of the bank determines the number of capacitors connected in parallel.

The basic operation of the voltage divider system is as follows: The first step of the bank is switched by means of a circuit breaker of the system voltage rating, capable of interrupting full system faults and having a current rating of at least 135% of rated current of the total bank. This step then becomes a voltage divider, each series group being a voltage increment equal to the capacitor voltage rating.

Switching of each additional step of the bank is then done at the voltage increment by single-phase oil switches. One switch is required for each series group of a step. A 115-kv bank of 8 series groups of capacitors per phase would require 24 switches for each additional step.

Isolating Transformers . . . All of the oil switches are remotely controlled. Each switch is raised above ground to the potential of the series group it is switching. The control circuit to the switch operating motor is also raised to the insulation level of the series group by means of 15-kv isolating transformers between each series group. A diagram of a one series group is shown in Fig 1. Each transformer has two 1:1 ratio units in a tank and provides 3-wire control to the switch operating motor.

The same 15-kv isolating transformers are also cas-

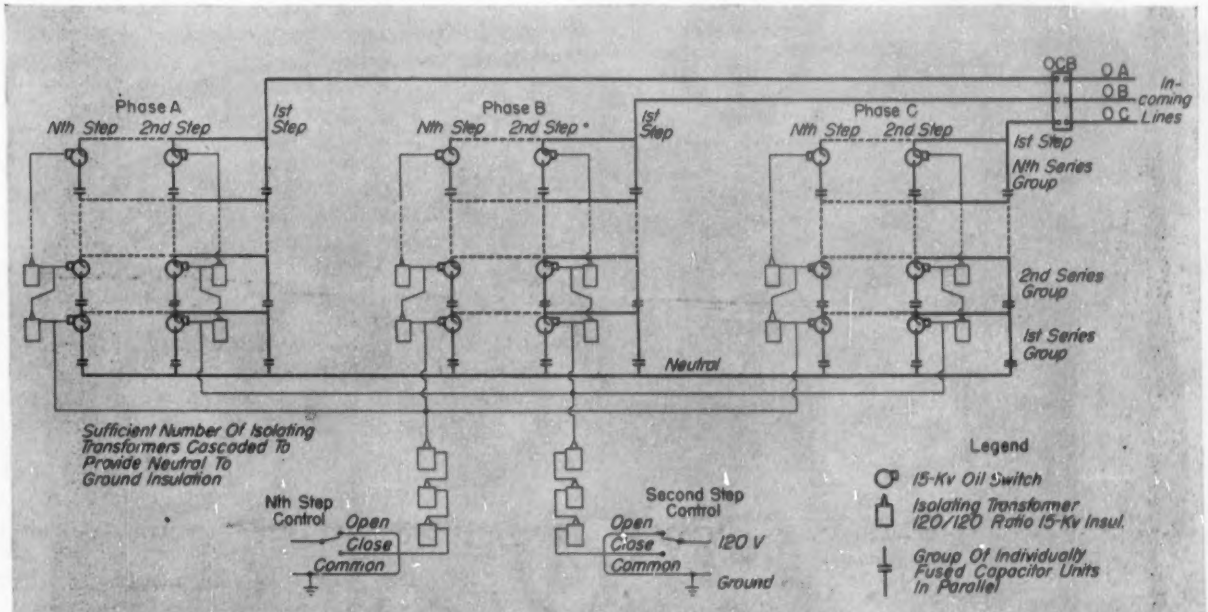


FIG 1— SERIES PARALLEL combination of high-voltage capacitor banks is basis of voltage divider switching method. Low-cost 15-kv oil switches are used to switch all but first step of multi-step capacitor banks of any rated voltage from 23 kv up to 230 kv

caded to provide neutral to ground insulation for floating wye banks. The use of standard components is more economical than the use of one isolating transformer of full neutral to ground insulation.

Random Switching . . . All of the oil switches for a step are energized at one time. However, as each switch operates independently, the opening and closing times of the switches in a given step are at random. All switches will close within approximately ½ sec and open within approximately 4½ sec of energization. As shown by the oscillograms of Fig 4, random switching actually produces a desirable effect because there is no system disturbance during the switching operation.

Oscillograms . . . The oscillograms show the switching of a 10,500-kvar, 46-kv bank of the Georgia Power Co by the voltage divider method. This bank has seven series groups of capacitors per phase. The bank is switched in two steps of 5,250 kvar each, the first step by a 46-kv oil circuit breaker and the second step by 21 mechanically operated switches (predecessors to the electrically operated oil switch). A neutral disturbance is shown on the oscillograms of Fig 4 as the first step is switched by the circuit breaker. No disturbance occurs when the second step is switched. The current increases or decreases in a smooth exponential envelope as the 21 switches operate at random.

Overvoltages . . . Because of the random closing of the switches, 60-cycle overvoltages occur on the various series groups during the switching operation. The highest overvoltage occurs when all but one switch of the second step is closed. The series group with the open switch then has fewer capacitors in parallel than the other groups and presents a higher impedance. The voltage across each series group is proportional to the impedance of the group. The magnitude of this overvoltage is a function of the number of series groups and the kvar ratio of the switched step to the already energized steps.

The overvoltages, shown in the curves of Fig 2, are of short duration unless one of the switches fails to function. In this event, the unbalance detection of the circuit will operate to remove the bank from the system. The kvar ratio of each step to the already energized steps should be designed so that the maximum voltage across the last series group to close will not exceed twice rated voltage.

Voltage Divider Step . . . The first, or voltage divider step of the bank, must have a minimum number of parallel capacitors in each series group. The correct number of capacitors insures proper operation of the individual capacitor fuses when one capacitor unit of a series group fails and limits the overvoltage on the remaining capacitors in the group to less than 110% of rating. Keeping the overvoltage below 110% eliminates the necessity of shutting down the bank immediately for maintenance when a single capacitor units fails.

Unbalance Detection . . . If the first step of the bank is large enough, it can be split into two banks with the neutrals connected through a current or potential transformer for detection of unbalance due to capacitor unit failures. The additional steps can then be switched on one side of the split bank. The bank need not be split equally for correct operation of the neutral unbalance detection circuit.

If the first step is not large enough to split, any of several other methods of unbalance detection can be used. Some of these are phase unbalance voltage, neutral-to-ground voltage, and neutral-to-ground current. An unbalance detection circuit has been omitted from Fig 3.

The additional steps of the bank can be of any size from one capacitor per series group up to a number having a

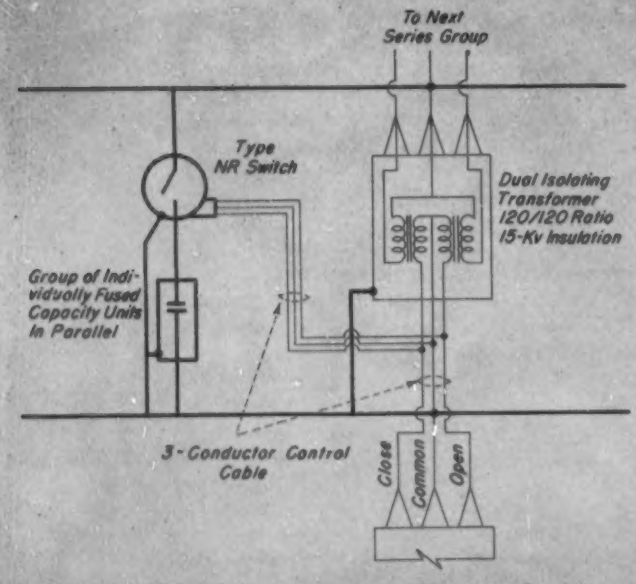


FIG 2—ONE SERIES GROUP schematic diagram shows isolating transformer (two 1:1 ratio units) and 3-wire switch for motor control connections

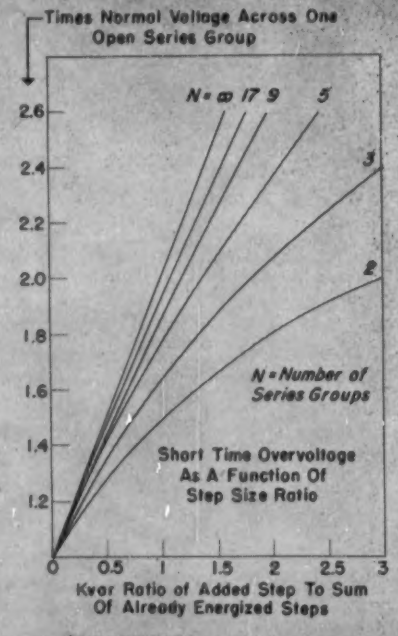


FIG 3—OVERVOLTAGE compared with step size ratio for the voltage divider switching method

current rating which is equal to the current rating of the switch. However, the steps must be of such a size that maximum allowable overvoltages that occur during switching are not exceeded. The number of additonal steps is not limited. Therefore, the size of the total bank switched is not limited. Switching of all steps of the bank can be either manual or automatic.

Future Plans . . . Georgia Power plans to use the voltage divider switching method on banks of 10,000 kvar or larger where the voltage bump occasioned by switching the bank as a unit would be excessive. It is very probable that Georgia Power will use electrically operated in lieu of mechanically operated switches in the future.

Standard Components . . . In planning such use, Georgia Power has in mind the fact that all components, including the 15-kv isolating transformers, are available and low priced. Spare switches and transformers can be stored at very little expense. In case of a failure, the defective unit can be easily replaced without shutdown.

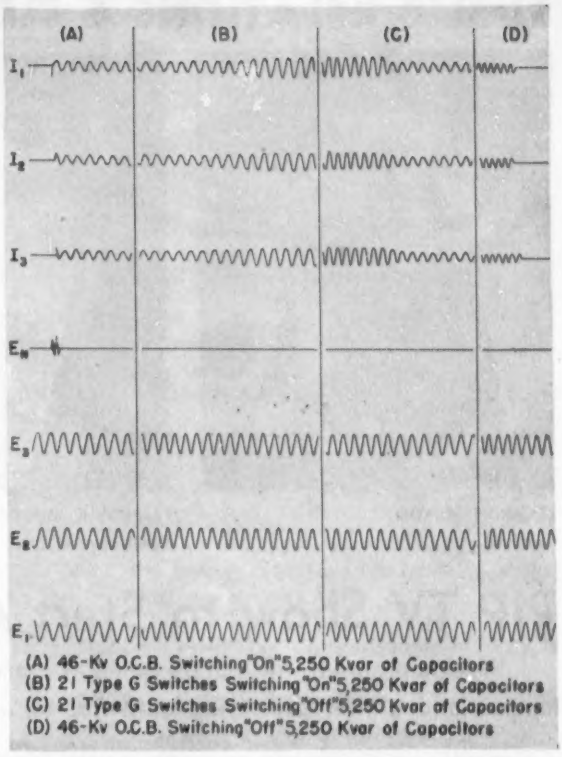
Low Maintenance . . . Easy and rapid maintenance of the switching method is another also important factor. The cost of the oil switch is so low that several spare units can be kept on hand to replace units on the bank whenever maintenance is required. Removing a switch unit and replacing it with another require only a few minutes. Total weight of a switch unit is about 46 lb, including oil. The control circuit to the operating motor can be disconnected by simply unscrewing the disconnect plug at the bottom of the motor control housing. As a result, down time on the bank can be kept to a minimum.

Economical Switching . . . Voltage divider switching provides an efficient and economical means of switching a capacitor bank on and off the system. It allows the bank to be rolled on and off smoothly, approaching the control offered by a synchronous condenser. The switching method is not only cheaper than switching with circuit breakers, but is better suited for capacitor switching. The switch and control transformer can be supplied, mounted and prewired on factory-assembled stacking units. This simplifies erection and minimizes field labor.

The oil switch is designed for capacitor switching. Because of the low inertia of its moving parts, it always opens extremely fast and restrikes freely, reaching a fully open position in less than one cycle. Restrike-free performance is an important factor in capacitor switching, but it is not always easily obtainable on large circuit breakers because of their great inertia. The switch has a voltage rating of 15 kv and a current rating of 200 amp. The current rating is reduced to 150 amp for capacitor loads to allow for excess current due to overvoltage, harmonics and the allowable 15% plus tolerance on the kvar of capacitor units.

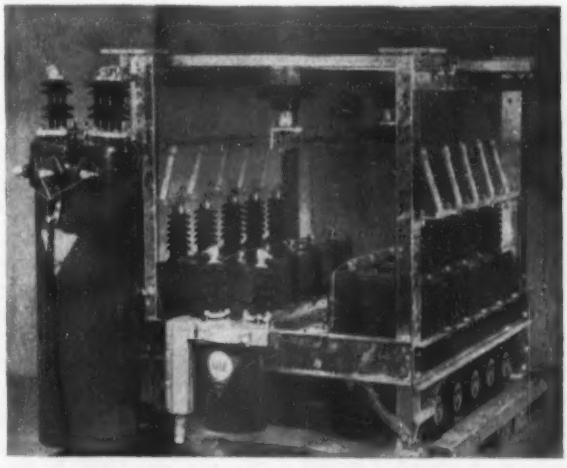
Transmission Circuits . . . Although the application of capacitors on distribution circuits usually is most advantageous, there are several important considerations which favor the installation of capacitors on the transmission and sub-transmission circuits.

First, the distribution circuits may already be corrected as far as is practical. Supplying the I^2X losses of the transmission and sub-transmission systems can then be done more economically on the higher voltage circuits than on the distribution circuits.



(A) 46-Kv O.C.B. Switching "On" 5,250 Kvar of Capacitors
(B) 21 Type G Switches Switching "On" 5,250 Kvar of Capacitors
(C) 21 Type G Switches Switching "Off" 5,250 Kvar of Capacitors
(D) 46-Kv O.C.B. Switching "Off" 5,250 Kvar of Capacitors

FIG 4—SWITCHING OSCILLOGRAMS of a two-step, 10,500-kvar, 46-kv Georgia Power capacitor bank using voltage divider method



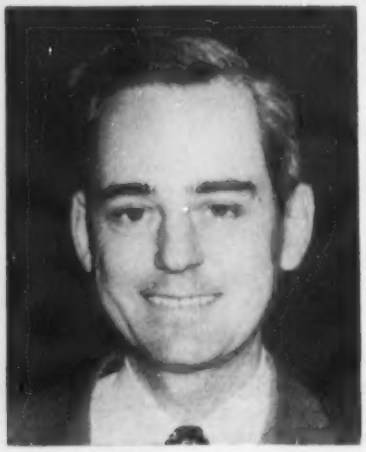
CAPACITOR STACKING UNIT (250 kvar, factory assembled) with oil switch and isolating transformer. Unit sizes vary 250 to 600 kvar

Second, the utility may not own the distribution circuits.

Third, rapidly increasing loads may require that large blocks of capacitors be installed in a hurry to provide temporary relief. Installation of large banks can be accomplished quicker than small banks on distribution systems.

Fourth, it may be desirable to have the capacitor bank under the supervision of the system operators to meet emergency conditions.

EDGARD H. DIXON
Panel Member



FRANCIS K. McCUNE
Panel Member

PIP TV Show to Start April 21

Weekly program will feature panel of prominent industrial leaders and a film portraying activities of a basic industry

"Better Living Television Theatre," a dramatic weekly film series portraying contributions made by American industry toward better living, will have its premiere April 21. The series is to run for 19 weeks. It will be carried by the DuMont Television Network as a public service program. Cooperating with DuMont is the Electric Companies Public Information Program.

The half-hour shows will begin at 10:30 PM (EST) each Wednesday through Aug. 25. Delayed telecasts of the program will be carried over many additional TV stations.

Over a score of prominent leaders of individual American industries will participate in panel discussions of outstanding issues of the day affecting their industries. These panels, which will be moderated by Fischer S. Black, editor of Electrical World, will add significance to each industry's story which follows on film.

Many Industries to Tell Own Story . . . The film features will take the audience behind the scenes of various business enterprises, many of which have been known only through their "end products." Industries will include electricity, atomic energy, steel, oil, railroads, construction, sanitation, and insurance.

The April 21 panel will be composed of R. E. Ginna, PIP chairman; Edgar H. Dixon, president, Middle South Utilities, Inc; and Francis K. McCune, manager, Atomic Products Division, General Electric Co. The film will be "A Is for Atom."

Combustion Engineering Runs Niagara Project Ad

Combustion Engineering, Inc, has publicly come out in favor of construction of the Niagara project by the five investor-owned New York electric companies. CE's action followed by some six weeks a similar endorsement by General Electric Co (EW, Feb. 8, p 73).

The firm, which manufactures steam generating and related equipment, like GE has its headquarters in the Empire State. It announced its stand on March 12 in full-page newspaper advertisements in all major New York cities.

Copy in the ad gave the company's reply to the two big arguments that have been advanced by public power advocates; namely, that the state can furnish power cheaply and that Niagara Falls is a natural resource belonging to the people; therefore, the people should develop it. Arguments in favor of construction by the five companies were given also.

The ad closed with this appeal:

"If you agree that the Niagara project should be a business rather than a government undertaking—wire or write the Senate Public Works Committee, Senate Office Building, Washington 25, D. C. You should also let your state and federal legislators know your views on the Capehart-Martin-Miller-Dondero Bill."

SCANNING THE ADS

Alabama Power Co—Campaign promoting electric clothes dryers has interesting head lines under clever linecut illustrations. Examples: "Soft as a kitten" with two kittens playing, "Soft as fleece with a lamb gamboling, "Gentle as a butterfly" with a butterfly gliding.

Carolina Power & Light Co—"The way to a man's heart is easier with electricity!" was the head over an ad promoting home freezers, refrigerators, ranges, and mixers. Theme was that these appliances enable wives to cook better meals for their husbands in less time.

Connecticut Light & Power Co—"Courage in the Rain" headed an ad which told of an eighth-grade student who saw two electric wires fall one rainy day and then with a friend kept people and cars from the wires until the company's service truck arrived.

Kansas Gas & Electric Co—"Lovely to look at . . . lovelier to see by . . . an ensemble of matching lamps" was head line over ad for lamps.

Metropolitan Edison Co—Series of ads on electric water heaters featured the contrast between not having and having such a heater. "Not having" copy was in a black reverse cut at upper left corner of illustration. "Having" copy was in a black reverse cut at bottom right of illustration. Example: "Don't let a cold shower get you down." "Have all the hot water you want all the time." Illustration showed a man in bath robe dashing down the cellar stairs.

New Orleans Public Service, Inc—Ad promoting New Orleans as location for industries had useful check list of advantages in that area.

WASHINGTON COMMENT

JESSE MOCK

Niagara hearings tied in with New York politics

Hearings before the Senate Public Works Committee during the past two weeks on Niagara power have thrown some light on the general political situation surrounding the issue. But they have produced little evidence that the committee is set for a showdown this year.

Unless there is some dramatic turn in future hearings that would bring about a decided shift in the attitudes of committee members, there is a good chance that a deadlock will result for the present session.

Testing His Ground . . . Close observers believe that Republican Chairman Edward Martin of Pennsylvania called the present round of hearings mainly to test the opinions of committee members. Martin, himself, believes that the five leading New York electric companies should develop the additional 1.1 million kw of power at the Falls with no financial help from the government. He has two or three other committee members who feel the same way.

But on the other side of the fence, there are at least six committee members who lean toward public development of the Niagara power. Not all of these six will go down the line with Gov Thomas E. Dewey's state plan of development, but they still would vote against the five-company plan.

As near as can be determined the other three members of the committee still have no strong views on the Niagara issue.

The factor that looms large above the Niagara power controversy is not the public-private power fight, but rather the political situation in New York. All committee members are aware that an all-important gubernatorial election is in the offing in that state, and that action on the Niagara power issue could be a deciding factor in the outcome of the election.

For Governor Dewey, an all-out backer of state development, Niagara legislation is really a test of power and influence. His stand for state development has been known for years and he testified last year for it before this same Public Works Committee.

Dewey's Neck Out . . . If he should lose, it would almost certainly be taken as a sign that his power is on the wane in affecting his state. He doesn't relish having to go before the electorate either as a candidate or as a Republican spokesman with such a defeat around his neck.

Republican members on the committee have some appreciation of his situation. They are not anxious to do anything that would hurt GOP chances in New York this year. Margins in the House and Senate are too close to take any political chances that can be avoided.

With this delicate situation in mind, it is believed that Senator Martin will move cautiously in handling this legislation. Because he feels very strongly that Niagara development should be a private enterprise job, he might try to bring out his bill this year. However, he will act only if he is sure that he can gain a solid committee majority.

Up to now, he has no such assurances. Nor have the hearings up to now produced the kind of convincing arguments that are likely to give him a stronger backing.

Appointment of Robert Moses as chairman of the Power Authority for the State of New York only complicated the situation as far as Martin is concerned.

It is this authority that would construct and operate the Niagara power facilities if the state plan should be approved.

One or two committee members that had previously been in the private enterprise camp are now leaning toward state development. They think Moses is well qualified to do the kind of job needed for Niagara development.

TECHNICAL NOTES

ARCHER E. KNOWLTON

Restarts of a shut-down turbine can be prompter if instrumentation and controls afford the temperature information and limitation requisite to operator confidence. Shortened warm-ups extend the time for week-end maintenance.

Alnico 5 contains by weight 8% aluminum, 14% nickel, 24% cobalt, 3% copper, and 51% iron. Its BH is tripled by heat treatment in a magnetic field.

Things made and used today will be the museum pieces in the next century, and everybody then will wonder how on earth people got along with such things (C. F. Kettering).

Two power sources must be provided for every essential bus of a plant auxiliary system. Complete loss of the unit should not be risked by dependence on a single source or feeder.

Silicone power factor from 1 kc to over 10 megacycles and from −35 to 150 C is less than 0.0001. At power frequencies the silicone-liquid shows 0.0002 to 0.0003 from 20 C to 100 C.

Switch contact shown by bolometer test to need attention was found to be dissipating almost 200 w.

Luminous ceilings for control rooms may fail to gain for control boards the dominant attention they deserve.

Zirconium, like austenitic stainless steels, has high electrical resistivity and low thermal conductivity.

Fans are attached to about 75% of all power transformers of 10,000 kva or more. Additional units have fans applied in the field.

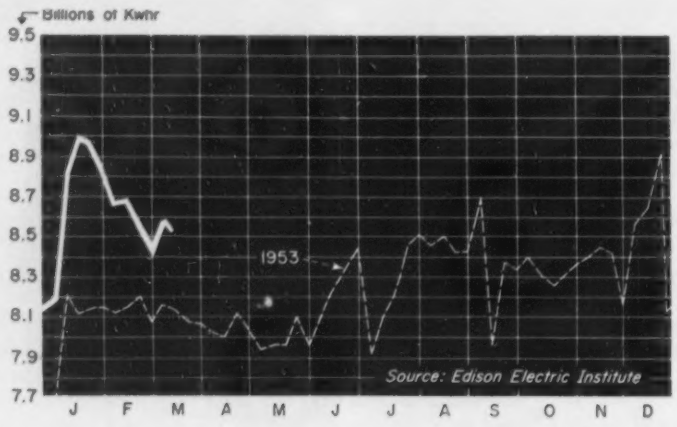
Inert gas welding is probably the most satisfactory method of joining or terminating aluminum conductor if conditions are such that it can be used.

Plant auxiliary power supply must be adequate when abnormal system or station conditions exist such as frequency or voltage that is either low or high.

Outage rate is apparently less (for circuits of modern design) the higher the voltage.

Half the total auxiliary requirements of a 400-Mw, 3,000-psi turbine will go to the boiler feed pumps.

STATISTICS



Output Week Ended Mar. 13—8,519,000,000 Kwhr

Seasonally Adjusted Index†—160.3

Per Cent Change From Previous Year

	Total US	New Eng.	Mid. Atlan.	Cent. Ind.	West Cent.	South-east	South Cent.	Rocky Mount.	Pacific NW	Pacific SW
Mar. 13	+4.7	−0.2	+0.2	−3.0	+9.5	+17.7	+8.1	+5.9	+8.1	+2.9
Mar. 6	+5.1	+0.9	+1.0	−3.4	+10.0	+20.6	+8.9	+4.9	+5.8	+0.9
Feb. 27	+4.0	+2.0	+0.8	−2.0	+7.5	+15.5	+9.0	+2.8	+7.2	−3.5

Electric Power Statistics

		Latest Month	Preceding Month	Year Ago
Peak Load (Million Kw)	Dec.	81.2	78.1	75.5
Capacity (Million Kw)	Dec.	91.49	89.81	82.05
Production (Billion Kwhr)	Dec.	39.06	36.38	36.45
Hydro	Dec.	8.67	6.91	8.22
Fuel	Dec.	30.39	29.47	28.23
Fuel Consumption				
Coal (Million Tons)	Dec.	10.87	10.17	10.75
Oil (Million Barrels)	Dec.	7.62	6.91	8.60
Gas (Billion Cu Ft)	Dec.	70.78	81.13	59.81
Sales (Billion Kwhr)	Dec.	32.31	31.59	31.20
Residential	Dec.	9.77	9.02	8.91
Commercial	Dec.	5.60	5.50	5.21
Industrial	Dec.	14.83	14.95	15.11
Other	Dec.	2.12	2.12	1.98
Net Income Class A & B Companies ($ Million)	Nov.	84.26	76.19	80.63
Estimated Dec. '54 Peak (Million Kw)	Dec.	94.0	94.7	96.0
Kwhr per Residential Customer (12 Month Average)	Dec.	2,345	2,331	2,169
Revenue per Kwhr Residential Service (12 Month Average)	Dec.	2.74¢	2.75¢	2.77¢
Canadian Production (Billion Kwhr)	Dec.	5.72	5.45	5.54

Business Statistics

FRB Industrial Production Index†	Feb.	125*	124	136
Gross National Production Annual Rate ($ Billion)	4th Qtr	363.5	369.5	361.1
EW 4 Industry Production Index†	Jan.	118.5	120.4	125.3
ENR Construction Cost Index††	Mar.	128.7	128.9	123.2
BLS Consumer's Price Index	Dec.	114.9	115.0	114.1
NEMA Insulation Materials Sales Index†	Jan.	124	133	174
NEMA Electric Appliance Sales Index†	Jan.	90	69	116
NEMA Household Refrig. Sales Index†	Jan.	95	53	93
Metal Prices (Mar. 16)				
Copper, Conn. V., lb		$.29¾	-.30 .29½	-.30 .29½
Lead, N. Y., lb		.13	.13	.13½
Zinc, prime Western E. St. Louis, lb		.09¾	.09¼	.11
Tin, Straits, qual. N. Y. lb		.92½	.85	1.21½
Aluminum, ingot, base price		.21½	.21½	.20½
Nickel, base price		.60	.60	.60
Steel, billets, Pitts., ton		62.00	62.00	59.00
Steel, scrap, No. 1 heavy, Pitts., ton		26.00	29.00	44.00

*Preliminary **Revised †1947-49=100 ††1949=100

UN Figures '52 Production Over 1 Trillion Kwhr

From Samoa to Sweden, or Somaliland to an estimate for the USSR, the United Nations Statistical Yearbook lists annual production figures for electric energy. The world total of industrial and utility generation (excluding Russia and China) came to 1,022,400 million kwhr in 1952, with North America and Europe alone accounting for 88% of that. The accompanying table lists totals for some of the largest producers.

World Production of Energy 1952

	Million Kwhr	
World*	1,022,400	
Africa	18,100	
Algeria	705	(P)
Belgian Congo	729	
Morocco (Fr.)	686	(P)
Union of South Africa	12,533	
Total, (% continent total)	14,653	(81%)
North America	539,700	
Canada	61,786	(P)
Mexico	5,337	
United States	463,056	
Total, (% continent total)	530,179	(98%)
South America	21,200	
Argentina	4,701	(P)
Brazil	3,082	(P)
Chile	1,872	(P)
Total, (% continent total)	9,655	(46%)
Asia	65,800	
China-Taiwan	1,420	(P)
India	6,125	(P)
Japan	51,647	
Turkey	1,018	
Total, (% continent total)	60,210	(92%)
Europe	362,000	
Austria	8,032	
Belgium	9,468	
Czechoslovakia	11,500	
Finland	4,498	
France	40,750	
Western Germany	56,208	
Hungary	4,000	
Italy	30,844	
Netherlands	8,498	
Norway	18,866	
Poland	12,700	
Spain	9,416	
Sweden	20,693	
Switzerland	12,709	
Great Britain	63,895	
Total, (% continent total)	312,077	(86%)
Oceania	15,600	
Australia	11,297	
New Zealand	3,610	
Total, (% continent total)	14,907	(96%)
USSR—estimate	117,000	

*Excluding USSR, China mainland and some small producers (P)—public use only, otherwise total is public plus industrial use.

CEI, CTS Sign Power Pact

Transit Board approves energy agreement negotiated between Cleveland Electric Illuminating and City Transit System

Cleveland Electric Illuminating Co and Cleveland Transit System have negotiated a power supply agreement for the remainder of 1954, with no increase in rates to the CTS. Final approval was given by Transit Board earlier this month. New agreement is a continuation, with minor modifications, of CEI-CTS power contract which expired Dec. 31, 1953.

The action puts off, for this year at least, any rate fight between the utility firm and CTS.

CEI Asks for Rate Hike . . . On Feb. 5, CEI notified all its customers it would seek, through the Public Utilities Commission, a general increase in rates throughout its service area and notified the city of Cleveland that its present rate contract would be cancelled Aug. 9, 1954. This increase would average 6.4% to all customers. The CTS power contract is not covered by this rate increase application since it is in the separate term contract category established by law and can be negotiated directly with the customer concerned.

Officials at CEI would not say why no increase is being asked of CTS at this time, when the utility would be within its rights to do so. They say the CTS rate schedule is "currently under study" and the present contract is being extended so that more time can be devoted to the project. They would give no indication whether CTS' rate would be raised when the present interim contract expires at the end of this year, beyond saying that "a request might be made in line with requests now before the Public Utilities Commission in regard to other customers."

Present Power Rates . . . At present, CTS power rates are set up as follows: $1.25 demand charge for each kilowatt of the billing demand per month, with a guaranteed minimum billing demand of not less than 20,000 kw; an energy charge of $0.009 per kwhr for the first 1.1 million kwhr per month, and a charge of $0.00475 per kwhr for any excess; and a sliding fuel adjustment cost pinned to the price of coal and providing that for every 1¢ per ton increase over $4 per ton, an additional charge of $0.00000625 per kwhr will be made. Should the price of coal go below $4 per ton, the same amount would be subtracted. Right now, a coal allowance of about $0.0018 is being added for each kilowatthour. CTS is now spending between $1 million and $1.2 million per year for power.

According to Donald Hyde, CTS general manager, the transit system, in contrast to residential and industrial power consumers, has had rate raises of approximately 30% in the past decade. The biggest increase came during the last rate battle between CTS and CEI in 1949, when about a 15% increase was granted.

It is Hyde's belief that CEI will hold back on further increases to CTS because the utility might well "price itself out of the market." Hyde explains that if CEI proposes further rate increases to CTS, the Transit Board will have to re-examine its entire proposed program of putting electric-powered trackless trolleys on such main arteries as Euclid Ave., Madison Ave., and W. 25th St. Overhead wires, left over from the streetcar era, are still standing on these lines.

Hyde states that CTS is finding more and better ways of maintaining its Diesel fleet economically, and that any further rate increase by CEI might cause the utility to lose money rather than make it. This fall, however, CTS will greatly expand its power needs when it opens the now-building east-west rapid transit line.

In making its across-the-board request for higher rates to the Public Utilities Commission last Feb. 5, CEI stated that it was the first general increase asked of the public in the company's 73-year history. CTS' Hyde believes that the public has had several raises in the past few years, since power hikes to CTS have been reflected in recent increases in Transit System fares.

Backs Fair Value Rate Base

The North Carolina Supreme Court has affirmed a fair value rate base for the Southern Bell Telephone & Telegraph Co, but has denied the company economic depreciation.

In its review of both the North Carolina Utilities Commission order and subsequent reversal of that order by the Superior Court of Mecklenburg County, the Supreme Court observed that "from 1945 to April, 1952, Southern Bell was granted applications for increases in its rates five separate times. The total amount heretofore allowed is $7,146,000. The last order allowing an increase was entered April 28, 1952, and this application for still another increase was filed July 21, 1952, only about three months thereafter."

"During this period, appropriately referred to as the postwar period, the net return of Southern Bell in the 19 states in which it operates has been approximately 4.8%, while in North Carolina, according to its figures, it has been 5.40%. During this period it has increased its capital stock from 175 million shares in 1945 to 615 million shares as of July 31, 1952 . . . "

Rates up 100% . . . The court continued: "The frequent grants of permission to Southern Bell to increase its rates has caused the monthly charges for telephones, during this postwar period, to increase by approximately 100%—in Raleigh from $5.25 to $10.25."

The court noted that the commission found the net original cost of the property to be $69,153,380 as of July 31, 1952, while of the same date the current cost of the property amounted to $80,142,950. After making certain adjustments the commission found that for rate making purposes the net investment of the company in North Carolina to be $68,599,569.

As to the rate of return, the court

noted the commission found that a 6% rate of return to be fair and just to the applicant and to the public and one which will produce additional gross revenue not in excess of $1,648,056. The company's original application was for $3,426,000.

The company, in its appeal to the Superior Court of Mecklenburg County, N. C., claimed that the commission had not found the fair value of the property as is required by the North Carolina law, and, secondly, it gave no weight to economic depreciation which the company claimed was essential in maintaining the integrity of its property.

The Superior Court found for the company on both these counts and remanded the case to the commission which appealed it to the Supreme Court of North Carolina.

In its findings, the Supreme Court stated, "The primary questions posed by appellant's assignments of error may be boiled down to one simple issue: Did the commission, in the consideration of the application of Southern Bell, follow the clear mandate of this statute, G. S. 62-124 (findings of fair value) [parenthesis supplied]? The court below answered in the negative. A full consideration of the record compels an affirmance."

Fair Return on Investment . . . As to the operation of public utility corporations, generally as compared with nonregulated enterprises the court said, "By no means the least of these governmental benefits **is the assurance that its stockholders shall have a fair return on their investment** [emphasis supplied]."

The court continued: " 'In fixing any maximum rate or charge, or tariff of rates or charges for any common carrier, person or corporation subject to the provisions of this chapter, the commission shall take into consideration if proved, or may require proof of, the value of the property . . . used for the public in the consideration of such rate or charge or the fair value of the service rendered in determining the value of the property so being used for the convenience of the public. It shall furthermore consider the original cost of construction thereof and the amount expended in permanent improvements thereon and the present compared with the original cost of construction of all its property within the state; the probable earning capac-

(Continued on page 208)

Today in Utility Finance

YIELDS (%)

Quality	Bonds			Preferred Stocks			Common Stocks		
	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd
DATE									
1954									
Mar. 11	**2.82**	**2.84**	**3.14**	**3.90**	**4.08**	**4.42**	**4.79**	**5.20**	**5.41**
Mar. 4	2.83	2.86	3.15	3.92	4.08	4.43	4.83	5.26	5.38
END OF QTR.									
4th 1953	3.07	3.12	3.34	4.17	4.32	4.62	5.07	5.57	5.51
3rd 1953	3.30	3.33	3.54	4.35	4.52	4.83	5.36	5.97	6.01
2nd 1953	3.34	3.46	3.64	4.47	4.70	4.88	5.52	5.93	6.10
1st 1953	3.15	3.23	3.39	4.16	4.41	4.66	4.95	5.24	5.50

Data: Reis & Chandler, Inc.

EARNINGS

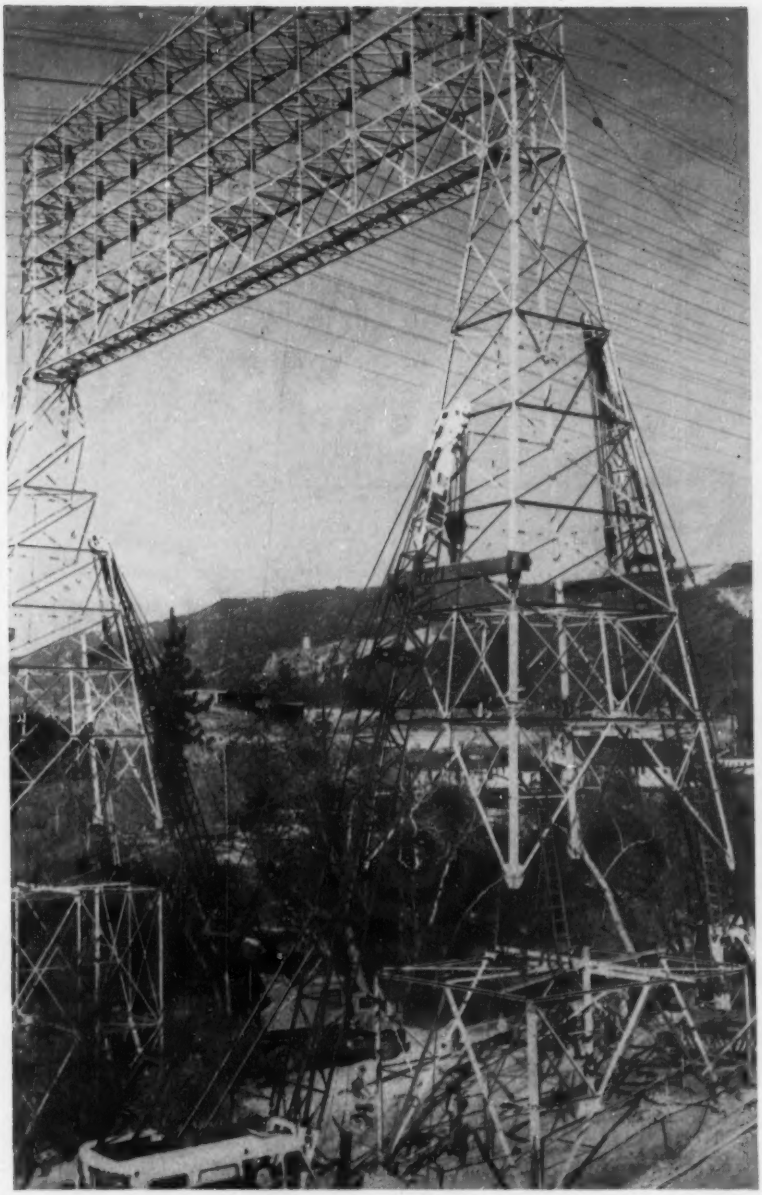
Company	Period Months Ended		Net Income 1954	Net Income 1953	Earnings Per Common Share 1954	Earnings Per Common Share 1953
Dallas Power & Light	12	Jan.	$5,030,465	$4,403,746	$....	$....
Gulf States Utilities	12	Jan.	9,445,800	7,285,342	1.87(a)	1.50(a)
Middle South Utilities, consolidated	12	Jan.	14,164,481	12,501,843	1.99(b)	1.88(b)
Montana Power and subsidiaries	12	Jan.	7,427,450	7,059,066	2.61	2.46
Portland General Electric	12	Jan.	3,814,238	3,693,262	2.54(c)	2.53(c)
Public Service of Indiana	12	Jan.	11 778,119	10,129,293	2.33(f)	2.40(f)
Tampa Electric	12	Jan.	2,550,208	2,339,571	3.55	3.34
			1953	**1952**	**1953**	**1952**
Atlantic City Electric	12	Dec.	$3,261,603	$2,779,980	$2.05	$1.83
Central Hudson Gas & Electric	12	Dec.	2,661,124	2,334,768	0.90(g)	0.85(g)
Central Illinois Light	12	Dec.	3,236,251	3,002,698	2.73(h)	2.78(h)
Consumers Power	12	Dec.	24,836,390	19,750,356	3.16(j)	2.65(j)
Hartford Electric Light	12	Dec.	3,435,223	2,681,542	3.29(i)	2.50(i)
Iowa Power & Light	12	Dec.	3,917,546	3,545,097	1.94	1.74

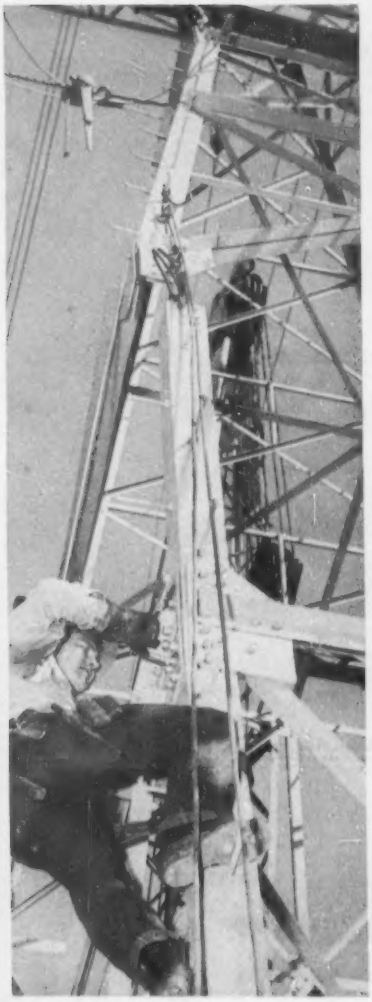
Notes—Figures shown for the last six companies have been audited; (a) Based on 4,221,832 shares in 1954 and 3,905,210 shares in 1953; (b) Based on 7,125,000 shares in 1954 and 6,650,000 shares in 1953; (c) Based on 1,500,000 shares in 1954 and 1,458,333 shares in 1953; (f) Based on 4,251,060 shares in 1954 and 3,780,768 shares in 1953; (g) Based on 2,259,642 shares in 1953 and 2,021,399 shares in 1952; (h) Based on 1,000,000 shares in 1953 and 900,000 shares in 1952; (i) Based on 949,500 shares; and (j) Based on shares outstanding at the year-end.

FINANCING

Company and Description	Amount of Offering (000)	Offering Price	Yield to Public
WEEK OF MARCH 11-17			
Bonds			
Alabama Power—1st mtg 3⅛% due 1984	$17,000	101.467%	3.05%
El Paso Electric—1st mtg 3⅛% due 1984	5,000	102.461	3.00
Pennsylvania Electric—1st mtg 3⅛% due 1984	12,000	101.665	3.04
Preferred Stocks			
El Paso Electric—15,000 sh 4.12% no par	$1,500	$101.98	4.04%
Common Stocks			
Wisconsin Public Service—316,867 sh (being offered commonholders on 1-for-7 basis, record Mar. 12 to expire Mar. 30; employees will get right to subscribe up to 10,000 shares of unsubscribed shares)	$5,830	$18.40	5.98%
SCHEDULE FOR MARCH—APRIL			**Bid Date**
Bonds			
Detroit Edison—1st mtg due 1984	$40,000	.....	Mar. 23
Pacific Power & Light—1st mtg due 1984	8,000	.....	Mar. 29
San Diego Gas & Electric—1st mtg due 1984	17,000	.....	Mar. 30
Georgia Power—1st mtg due 1984	11,000	.....	April 6
Community Public Service—1st mtg due 1984	3,000	.....	April 6
Central Power & Light—1st mtg due 1984	18,000	.....	April 12
Southern Indiana Gas & Electric—1st mtg due 1984	8,000	.....	April 13
Ohio Power—1st mtg	20,000	.....	April 14
Los Angeles Department of Water & Power—electric plant revenues due 1955-84	15,000	.....	April 14
West Penn Power—1st mtg due 1984	12,000	.....	April 20
Preferred Stocks			
Louisiana Power & Light—70,000 sh $100 par	$7,000	.....	Mar. 23
Dallas Power & Light—70,000 sh no par	7,000	.....	Mar. 24
Rochester Gas & Light—50,000 sh $100 par	5,000	.....	Mar. 25 (b)
West Texas Utilities—60,000 sh	6,000	.....	April 8
Ohio Power—50,000 sh $100 par	5,000	.....	April 14
Northern States Power (Minn.)—150,000 sh $100 par	15,000	.....	April 20
Arkansas Power & Light—70,000 sh $100 par	7,000	.....	April 20
Common Stocks			
Utah Power & Light—200,000 sh	.....	.....	Mar. 23
Southern Indiana Gas & Electric—114,166 sh (to be offered commonholders on a 1-for-7 basis, record Mar. 24 to expire April 8)	.....	.....	.....(a)
Pennsylvania Power & Light—704,917 shares (to be offered commonholders on a 1-for-7 basis, record April 2)	.....	.....	.....
Texas Utilities—250,000 sh	.....	.....	April 13
Northern States Power (Minn.)—1,219,856 sh (to be offered commonholders on 1-for-10 basis)	.....	.....	.....

Notes—(a) Smith, Barney & Co, underwriters; (b) First Boston Corp, underwriters.





↑ Extension legs are bolted to tower base after . . .

← Structure was raised 7 ft by four mobile cranes

Mobile Cranes Lift 77,000-Lb Tower 7 Ft

Additional height to clear a super highway under construction was built into a Southern California Edison Co multicircuit steel bridge-type transmission tower while the structure was raised by mobile cranes. Four 35-ton capactiy cranes held the tower carrying 11 energized 66-kv circuits in an elevated position until eight 7-ft extensions could be bolted into position.

The transmission structure, weighing 77,000 lb, is a 98-ft bridge supported by two towers, one 130 ft high and the other 116 ft high. The shorter tower is located on a hillside.

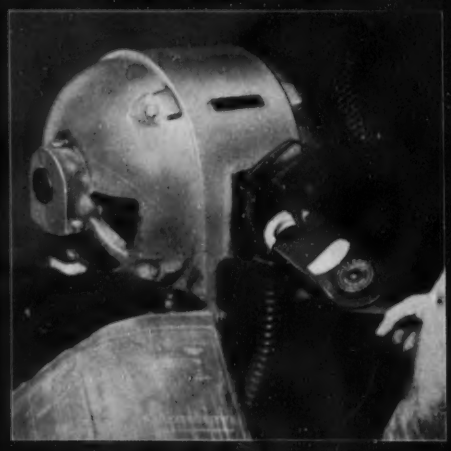
Mobile cranes were positioned opposite to each other, two to a tower. To begin the operation, a slight tension was applied simultaneously by each crane so that tower bolts could be loosened more easily. The structure was lifted slightly more than 7 ft and the extensions were bolted to the bases. Then the structure was carefully lowered into position and held while extensions were bolted to the towers.

Each tower leg was multi-guyed in two directions during the operation as a safety precaution.

1 **AVAILABLE FOR THE FIRST TIME,** General Electric's CF-7 hook-on recording volt-ammeter now makes it possible for you to get 30-day records of current, without cutting conductors or interrupting service. This new kind of recorder also gives you voltage records over a wide range. Seven ranges provide a maximum number of applications at a minimum instrument investment (15/75/150/750 amperes; 150/300/750 volts). An external range switch simplifies range changing.

AK-2 MEASURES BOTH WATTS AND VARS

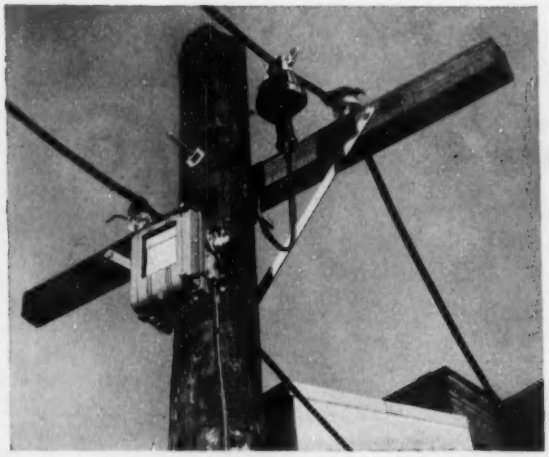
Why General Electric Hook-on Indicators Save You Time



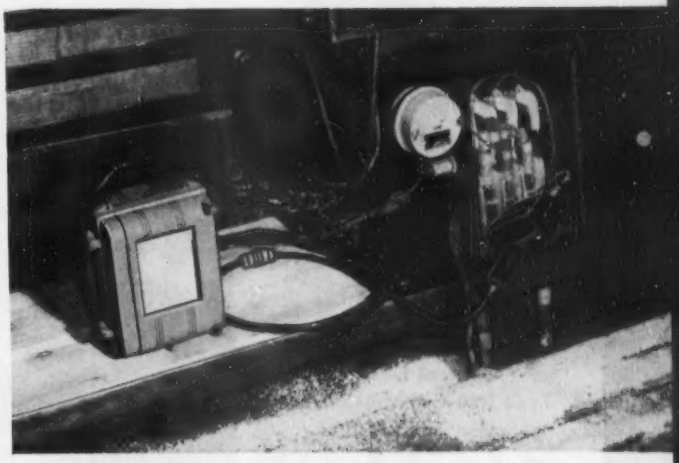
EASY HOOK-ON INSTALLATION and finger-tip range selection are features unique to this G-E wattmeter, which quickly determines single- and polyphase kilowatts and vars in balanced 3-phase circuits. Use the hook-on wattmeter to locate overheated motors before trouble starts. Simply clip voltage leads across lines, hook transformer on to conductor, and read in kilowatts.

Completely New G-E Hook-on Recorder Records Amps Without Interrupting Service

CARRIES ASA INSULATION RATING OF 8700 VOLTS

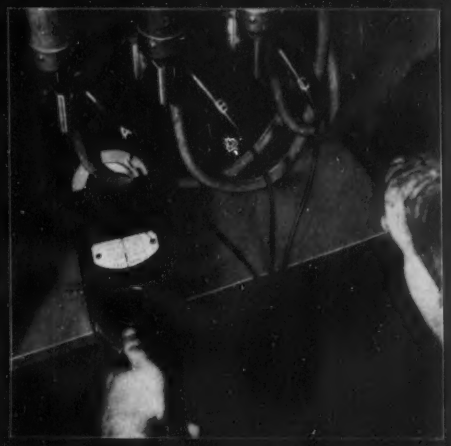


2 **SAFE AND ACCURATE:** Butyl molding makes possible a transformer insulation rating of 8.7 kv. Even high-voltage circuits may be tested. Calibrated accuracy is ±3% of full scale (4% above 625 amperes).



3 **FAST, CONVENIENT INSTALLATION:** Application of the hook-on principle to the CF-7 makes installation a simple matter. Merely connect the recorder to a suitable power supply, select proper range, and hook on to conductor.

AK-3 INDICATES POWER FACTOR DIRECTLY



SECTION A602-279
GENERAL ELECTRIC COMPANY
SCHENECTADY 5, NEW YORK

Please send me a copy of the bulletin(s) checked below:

.....GEC-901 AK Hook-on Indicators

.....GEA-6104 CF-7 Hook-on Recorder

Name.....

Company.....

Street.....

City.....Zone.....State.....

NO CALCULATIONS NECESSARY with this handy power-factor indicator. Accurate to within 0.05 PF, the AK-3 provides a direct reading of leading or lagging PF on any balanced 3-phase circuit.

By detecting low PF with the AK-3, you can determine the need for capacitors. Notice that there are no complex connections; just clip on leads, hook on, and rotate dial for reading.

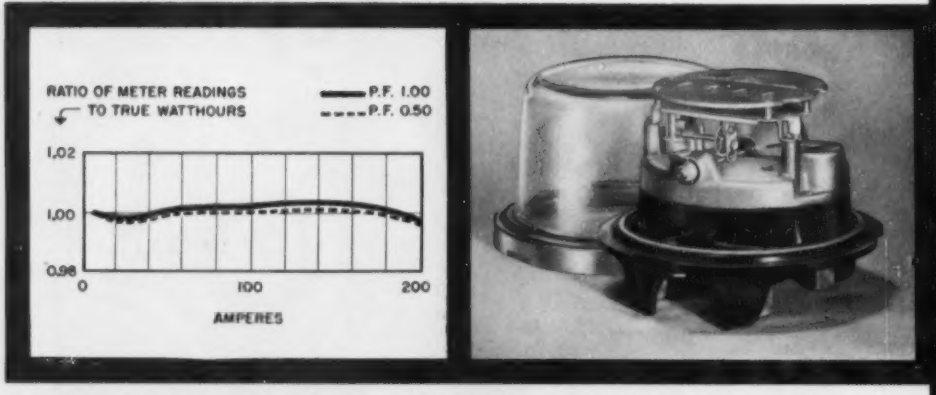
FOR DETAILS on how G-E hook-on instruments can save you time by simplifying measurement, contact your Apparatus Sales Representative or clip and mail coupon for free bulletins.

GENERAL ELECTRIC

NEW

General Electric Type I-50 watthour meter, rated 50 amperes

NEWEST MEMBER of the General Electric I-50 family, the 50-ampere I-50 watthour meter has performance characteristics comparable to the proven 15-ampere I-50. Newly designed current coil construction and light-load plate assure greater accuracy.



1 **STRAIGHT-LINE ACCURACY** up to 200 amperes, as shown in these load curves, means greater stability and dependability in all applications of this new G-E meter.

2 **UNIT CONSTRUCTION** of new 50-amp I-50 helps assure inherent high accuracy over many years, reduces testing and repair expense.

✻ **FOR A SAMPLE DEMONSTRATION** of the new General Electric 50-ampere I-50 watthour meter, newest member of the growing I-50 family, or for more information, contact your nearest G-E apparatus representative, or write: Section 601-103, General Electric Co., Schenectady 5, N. Y.

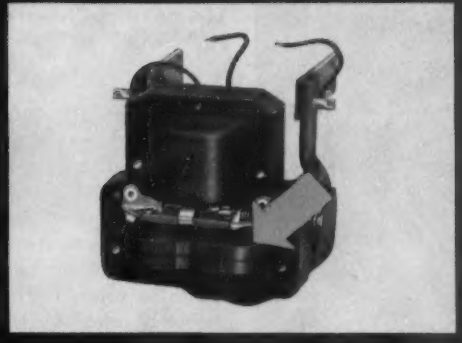
50-ampere I-50 watthour meter—

Another new member of the I-50 family

5 REASONS WHY THIS

NEW G-E METER*

WILL LOWER YOUR METERING COSTS



3 **MAGNETIC SUSPENSION SYSTEM,** identical to the 15-amp I-50's "floating disk," eliminates bearing wear, keeps maintenance cost to minimum.

4 **COMPLETELY NEW STATOR** design with butyl-molded current coil assembly (arrow) eliminates possible changes in calibration, assures consistent, high insulation level.

5 **NEW 50-AMPERE METER** incorporates all the proven features of the 15-amp I-50 meter to bring you greater dependability and accuracy.

GENERAL ELECTRIC

PLANTING WILLOWS in fly-ash bed was done during month of April by three men. Willows are spaced about 6½ ft apart

WILLOWS GROW in a fly-ash bed. A few of the 6,900 that were planted were killed by rodents and some were washed out

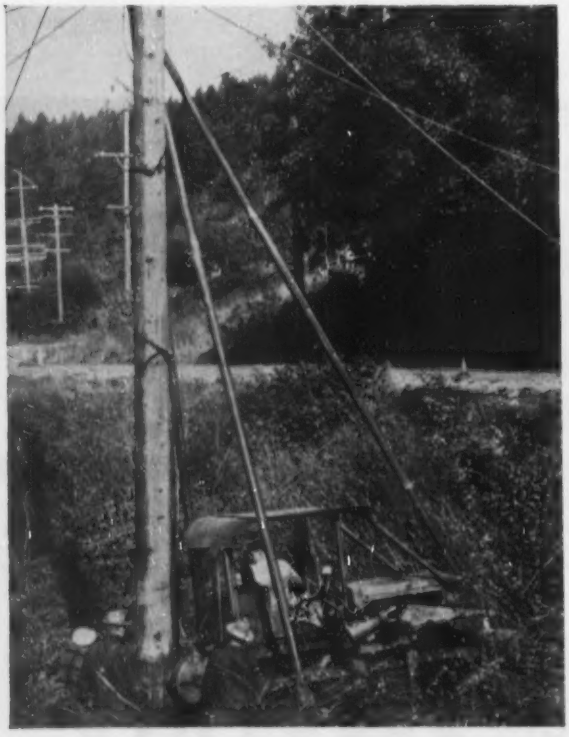
Can Willows Stabilize Flyash Bed?

In an attempt to stabilize the flyash bed at its B. C. Cobb Plant, Consumers Power Co has planted willow cuttings in the dike-enclosed marshland. The experiment is under the direction of R. H. O'Neil, the company's forester.

Cuttings, 30 in. long, were secured from a hedge-row of black willows at the beginning of each day's planting. They were tied together in bundles of 25 and wrapped with wet burlap to keep them from drying out prior to planting.

At first, iron bars were used to punch holes for the cuttings, approximately 6½ ft apart, in the ash. This was found to be unnecessary because cuttings could be pushed into the flyash without injury to the cambium.

A three-man crew cut, bundled, and planted 6,900 willows during April. Spring and summer losses were negligible. Rodents, probably muskrats, killed a few cuttings by eating the bark from them. Some others were washed out by the water carrying the flyash. But most of the cuttings took root and are growing, as shown in the illustration.



DRIVING POLES in swampy ground is done with a bulldozer, which also pulls the pole into place and lifts it to upright position

Bulldozer Drives Pole Into Swampy Bog

LEN HAYDEN, Division of Power Supply, Puget Sound Power & Light Co, Sumner, Wash.

Puget Sound Power & Light Co uses a bulldozer as a pile-driver when setting poles in swampy ground. The "cat" drags the pole into place, lifts it upright with the boom, then drives the pole into the ground as its weight pulls straight down on the winch line, which chokes the pole 15 ft above the ground. Men with hand lines hold the pole plumb during driving.

As the winch line is wound on the drum, the pole is depressed into the ground. When firm ground is encountered in the bog, the end of the bulldozer may be lifted several feet off the ground. The winch is released momentarily to permit the bulldozer to fall free but the line is snapped taut before the tractor treads touch ground. Three such yanks will drive a 65-ft pole 8 ft into soft ground.

Blanket Installation of Capacitors Saves $320

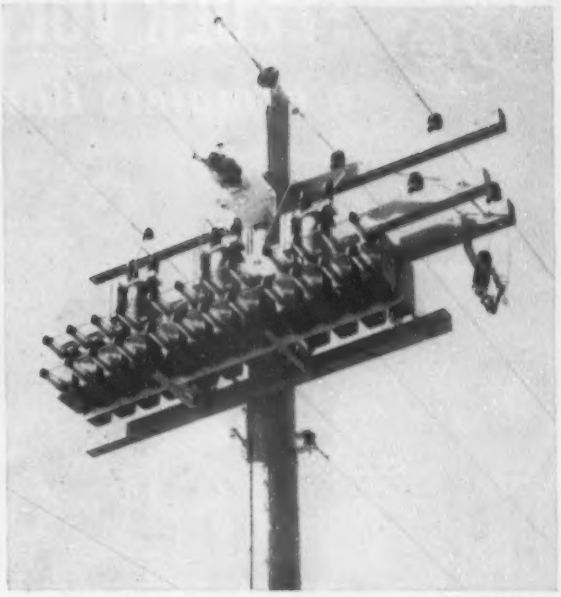
DON E. HAASCH, Senior Engineer, Idaho Power Co, Boise

Installation of distribution capacitors on an area basis saved Idaho Power Co an estimated $320 in engineering and installation time compared with installing units on an individual substation basis. The complete project covered the placing of 8,000 kvar of banked units on 15 rural feeders to serve anticipated increases in pumping load. Savings due to blanket installation are estimated as 25% of engineering time and 20% of installation time, or about 40 cents for every kvar of capacitor that was installed.

In 1953 a large increase in pumping load was scheduled on the ends of feeders on three substations in the eastern division. Calculations indicated that without additional capacitors the resulting power factor and load would result in excessive voltage drop on the 12.5-kv feeders and the 46-kv transmission system. The division area is well over 200 miles from the base operating point of company mobile construction crews. Thus, if engineering and installation were done on a substation basis, organization and travel time would include a sizable duplication of effort.

The first step of canvassing the entire area to determine the location and need for individual banks took 10 days. Included in the division are 15 feeders, five substations and about 600 pole-miles of line. From information on transformers, type of load, phasing, and source of feed, load and voltage profile charts were made and capacitor locations determined.

In all 8,000 kvar of capacitors were required, with 6,000 kvar to be switched and 2,000 kvar to be fixed. Banks consisting of 12 units rated 25-kvar each were used. With this amount of capacitors to be installed, it was economical to put three installation crews on the project.



ONE OF MANY is this 300-kvar bank of switched capacitors installed at a saving of about 40 cents per kvar. Three crews placed poles, raised units, and connected controls and energized banks

The first crew travelled each feeder and placed new poles for the switched banks. They were followed by the second crew that installed the banks, while the third group connected the controls and energized the banks. This production line method assured the greatest efficiency, particularly as each crew gained experience with the individual tasks. Total construction time to install 8,000 kvar was but six weeks.

TESTING CURRENT TRANSFORMERS is accomplished in 30 sec after the set-up has been made and operator is in position

Current Transformers Tested Quickly

Memphis Light, Gas & Water Div developed a panel, using the Knopp instrument, current-transformer test set, for quickly testing current transformers in their laboratory.

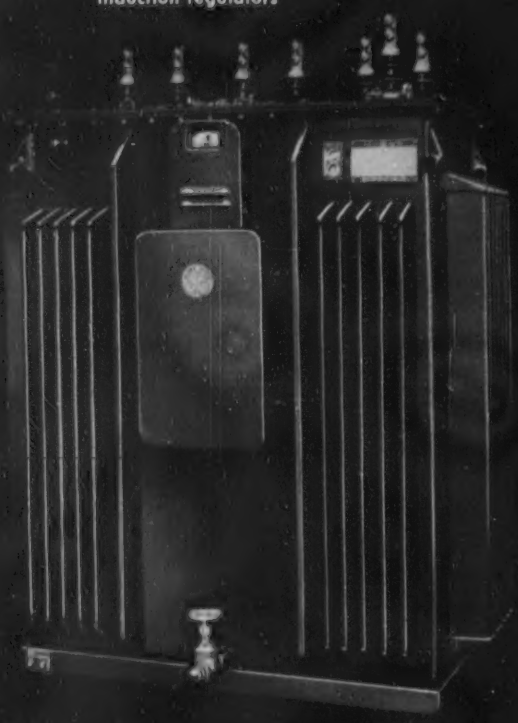
Current transformer under test is clamped in position quickly with clamp-on pliers. Once the set-up has been made and with meter tester standing in position, only 30 sec are required for the test. One man can test 65 to 70 CT's a day.

Loading transformer on the test panel has a standard CT with a ratio range from 600/5 to 5,000/5. Loading transformer itself handles ratios of current transformers under test up to 600/5.

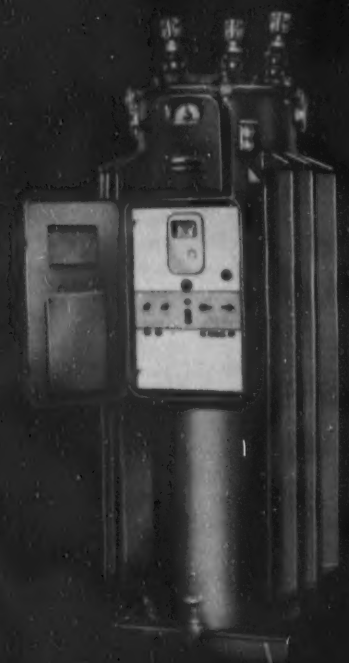
The board has a wattmeter, ammeter, voltmeter, and a low power-factor wattmeter. It also includes switches for standard calibration, supply, burden, and operation as well as a phase shifter.

FEEDER VOLTAGE REGULATORS

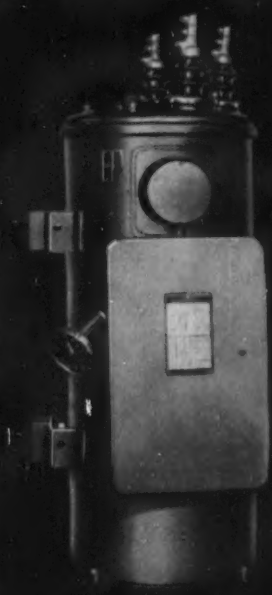
a complete line of both step and induction



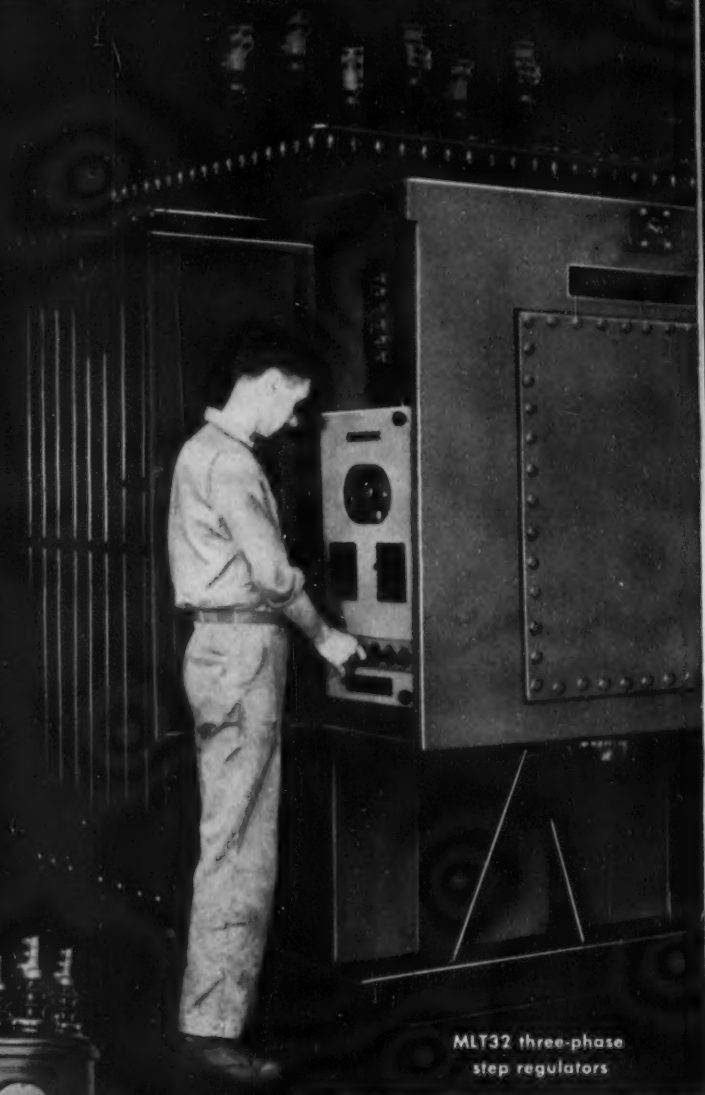
IRT three-phase
induction regulators



IRS single-phase
induction regulators



ML32 single-phase
step regulators



MLT32 three-phase
step regulators

ADVANTAGE OF CLASS 1 ACCURACY is illustrated in diagrams at right which show how a reduction in *effective* bandwidth permits a greater voltage drop in primary, transformer, and secondary while maintaining the same voltage standards from first to last consumer.

regulators with the economy of

Class 1 Accuracy at no extra cost

Whatever your voltage problem, you'll find a dependable, low-cost solution in this complete line of General Electric feeder voltage regulators.

G-E Induction Regulators, available for circuits up to 15 kv and 3000 kva, provide smooth, stepless control and need virtually no maintenance. For close regulation of single-phase feeders where operations are frequent and immediate voltage correction is required, G-E Type IRS single-phase induction voltage regulators offer the finest regulation obtainable. Their rugged operating mechanism and the elimination of switching contacts give you a maintenance record unbeaten anywhere. Type IRT three-phase induction regulators offer the same advantages of rugged construction, long life, and negligible maintenance.

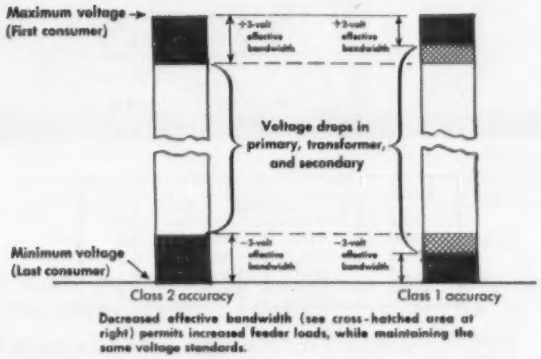
G-E Step Regulators assure dependable and economical regulation where you handle large blocks of power, and where you need supplementary regulation on your branch and rural feeders. For three-phase circuits, station-type MLT32 regulators adjust voltage in thirty-two 5/8% steps (Best suited for lines with balanced loads). They feature accessibility and ease of maintenance of switching mechanism. G-E Type ML32 single-phase step regulators also adjust voltage in thirty-two 5/8% steps, and give low-cost, dependable regulation on branch and rural circuits.

Class 1 Accuracy, the highest accuracy classification defined by ASA Standards, is a standard feature on *all* G-E voltage regulators. When compared with regulators with Class 2 or Class 5 accuracy, the G-E regulator with Class 1 accuracy permits (1) greater feeder length at the same load density, (2) greater load on existing feeders, or (3) higher voltage standards on existing feeders. Insist on Class 1 Accuracy controls. They mean *dollars* in your pocket with not one additional *cent* in investment.

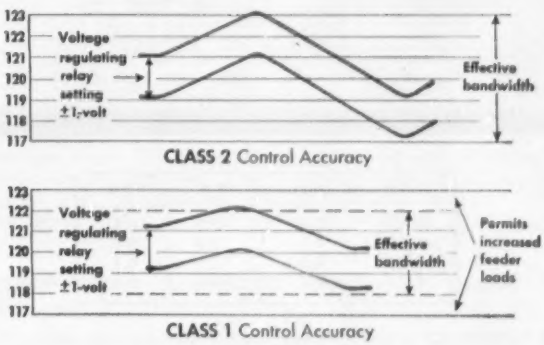
For More Information about G-E voltage regulators, contact your nearest G-E Apparatus Sales Office or authorized agent. Or write Section 423-4, General Electric Company, Schenectady 5, New York.

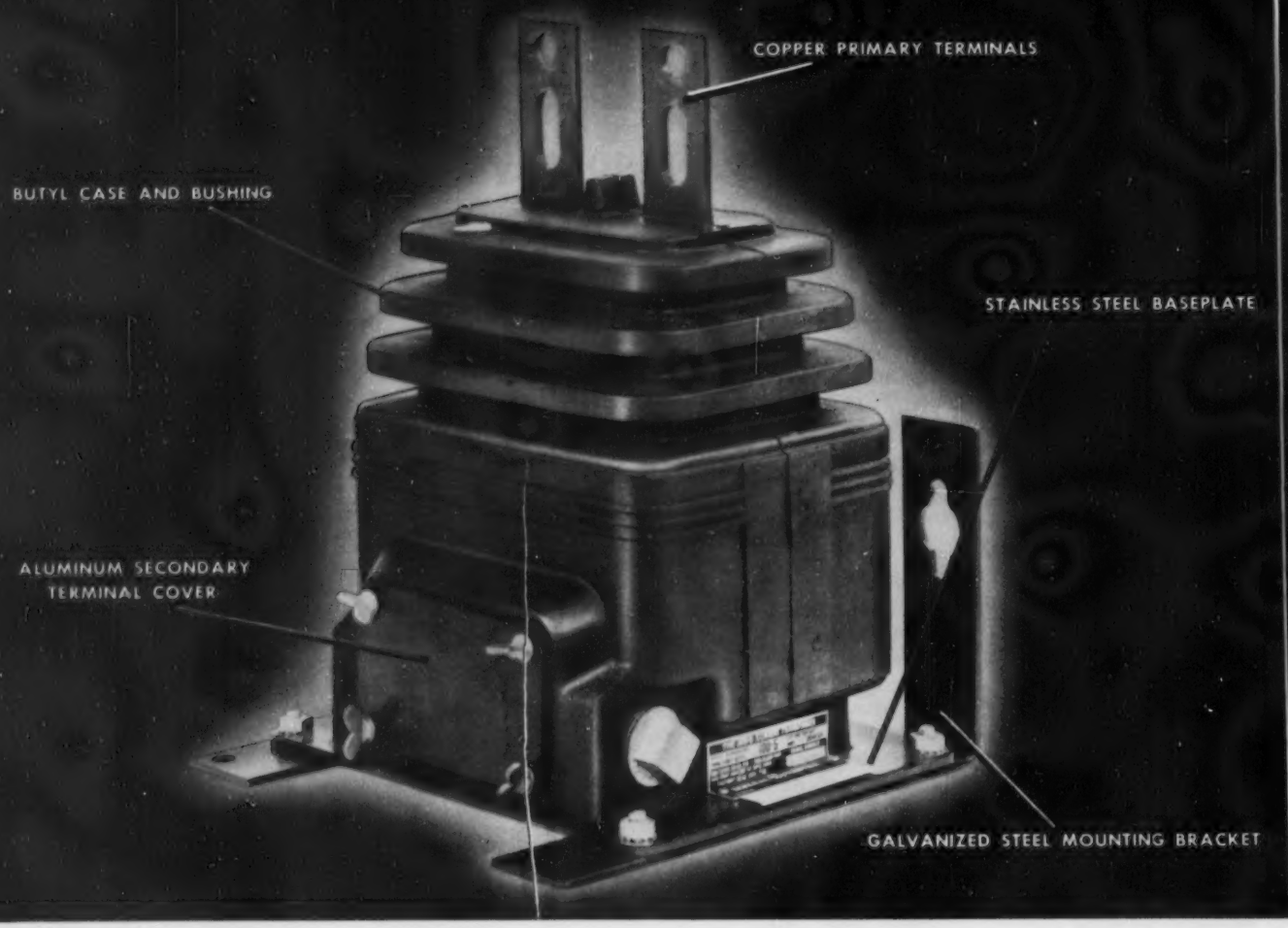
Progress is our most important product

GENERAL ELECTRIC

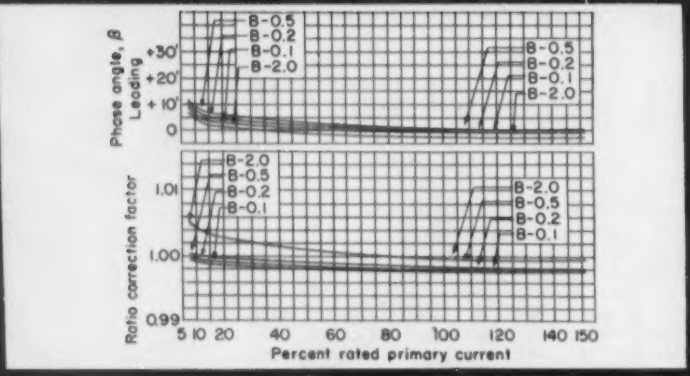


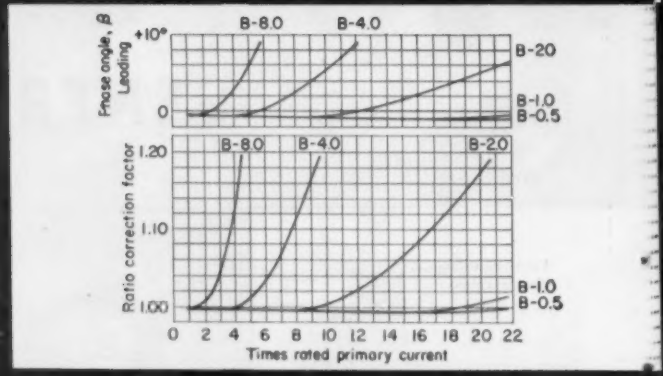
Decreased effective bandwidth (see cross-hatched area at right) permits increased feeder loads, while maintaining the same voltage standards.





1 **CORROSION-RESISTANT** materials—butyl, stainless steel, aluminum, galvanized steel, copper reduce maintenance to minimum.





5

Burden	Imp.	V-A	P-f
B-0.1	0.1	2.5	0.9
B-0.2	0.2	5.0	0.9
B-0.5	0.5	12.5	0.9
B-2.0	2.0	50.0	0.5

Burden	Imp.	V-A	P-f
B-0.5	0.5	12.5	0.9
B-1.0	1.0	25.0	0.5
B-2.0	2.0	50.0	0.5
B-4.0	4.0	100.0	0.5
B-8.0	8.0	200.0	0.5

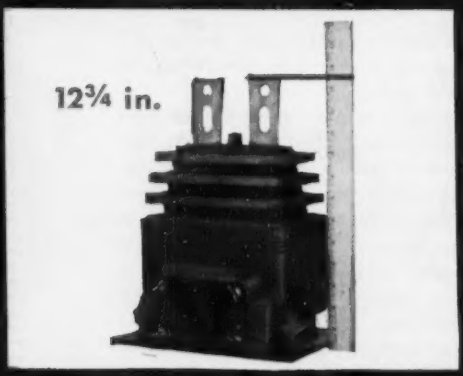
HIGH ACCURACY of new G-E current transformer is illustrated in these characteristic ratio and phase angle curves at 60 cycles. At left: 10 to 800 amperes, with normal current; at right: 10 to 800 amperes, up to 22 times rated primary current.

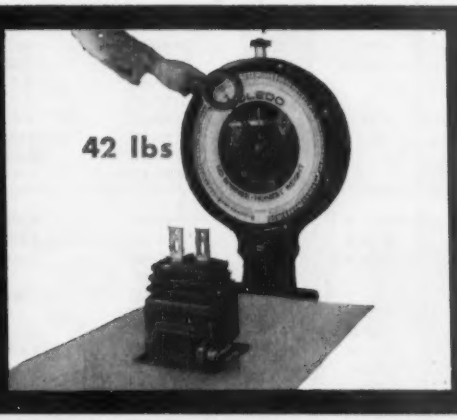
New JKW-3 is suitable for accurate metering down to 5% of rating and for relay operation up to twenty times rated current. The ASA accuracy classification of this transformer is 0.3 at burdens: B-0.1 to B-2.0.

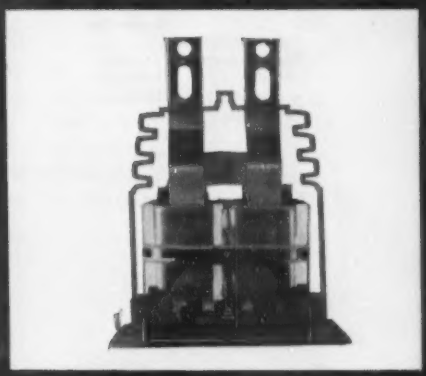
GENERAL ELECTRIC ANNOUNCES

A 5000-volt butyl-molded current transformer for outdoor applications

NEW TYPE JKW-3 OFFERS SIX MAJOR FEATURES



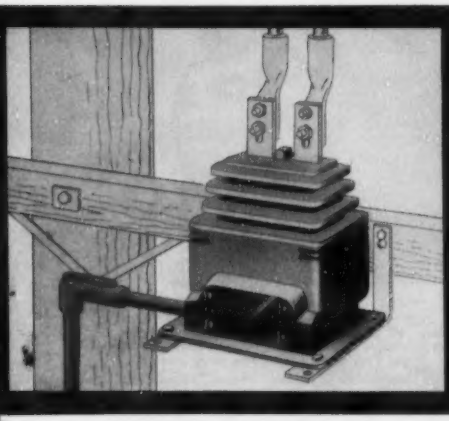


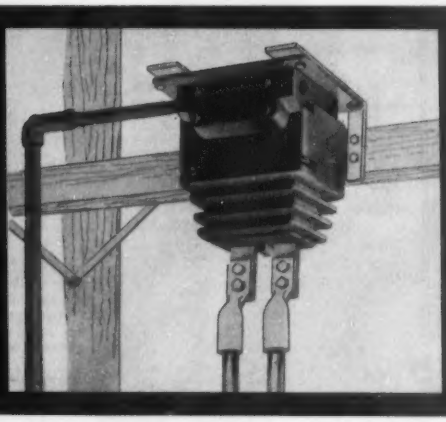


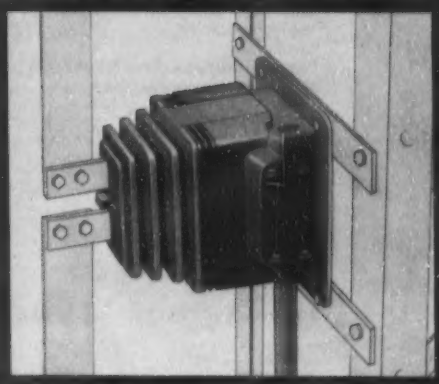
2 **ONE THIRD SMALLER** in all ratings than other top-connected 5 KV designs, the new General Electric JKW-3 transformer is easier to install.

3 **LIGHT WEIGHT** of current transformer, only 42 pounds, facilitates handling and installation. Weighs 1/3 less than other top-connected 5 KV outdoor designs.

4 **UNIFIED CONSTRUCTION OF JKW-3** assures high mechanical strength. Butyl serves as insulation, case, and bushing.







6 **VERSATILE MOUNTING,** the new General Electric JKW-3 transformer is applicable to bottom- top- or side-connected installations. It can be platform-mounted, bolted directly to a crossarm, or attached by U-bolts or suspension hooks. This versatility of positioning and mounting reduces installation cost. Two L-shaped brackets are supplied with each transformer. Auxiliary L-brackets for U-bolt mounting and suspension hooks are available upon request.

FOR MORE INFORMATION on the new G-E 5000-volt outdoor current transformer, contact your nearest G-E representative, or write for Bulletin GEC-1222 to Section 604-39, General Electric, Schenectady 5, N. Y.

GENERAL ELECTRIC

Properties of Alathon, Teflon and Nylon

A quick reference tabulation of electrical, mechanical, thermal and other properties, and uses for the thermoplastics in molded form.

Data for these thermoplastics furnished by E. I. duPont de Nemours & Co.

Property	Unit	Method	ALATHON (polythene resin) Molded 1	TEFLON (tetrafluorethylene resin) Molded TF-1	NYLON (powder) Molded FM-3001
Electrical					
Dielectric strength, short-time	v/mil	D149-44	460	480	470
step-by-step	v/mil	D149-44	420	430	410
Volume resistivity	ohm/cm	D257-46	$>10^{15}$	$>10^{15}$	4×10^{14}
Dielectric constant, 60 cycles	.....	D150-47T	2.3	2.0	4.6
10^3 cycles	.....	D150-47T	2.3	2.0	4.5
10^6 cycles	.....	D150-47T	2.3	2.0	3.5
Power factor, 60 cycles	.....	D150-47T	<0.0005	<0.0005	0.04
10^3 cycles	.....	D150-47T	<0.0005	<0.0005	0.04
10^6 cycles	.....	D150-47T	<0.0005	<0.0005	0.03
Mechanical					
Tensile strength, −70 F	lb/sq in.	D638-46T	7,600	.....	12,900
77 F	lb/sq in.	D638-46T	1,300	1,800	7,000
170 F	lb/sq in.	D638-46T	1,000	1,000	6,760
Elongation, −70 F	%	D638-46T	50	.....	2.0
77 F	%	D638-46T	200	110	90
170 F	%	D638-46T	375	600	320
Modulus of elasticity, 77 F	lb/sq in.	D638-46T	19,000	58,000	260,000
Shear strength	lb/sq in.	D732-46	2,200	3,800	8,400
Impact strength, Izod, −40 F	ft-lb/in.	D256-47T	1.6	2.0	0.6
70 F	ft-lb/in.	D256-47T	>16	4.0	1.0
Stiffness, 77 F	lb/sq in.	D747-48T	13,000	60,000	150,000
Flexural strength, 77 F	lb/sq in.	D790-45T	(1)	did not break	8,000
Compressive stress at 1% deformation	lb/sq in.	D695-44T	280	670	3,000
Creep in flexure	.....	.....	(1)	67	120
Hardness, Rockwell	.....	D785-48T	.....	.....	R111
Shore durometer	.....	D676-47T	D45	D55	.....
Thermal					
Flow temperature	deg F	D569-48	224	(1)	397
Coefficient of linear termal expansion per deg F	.....	D696-44	9×10^{-5}	3.5×10^{-4}	8.2×10^{-5}
Thermal conductivity	BTU/hr/sq/ft/deg F/in.	(2)	2.3	1.7	1.5
Specific heat	.....	.....	0.55	0.25	0.4
Deformation under load, 122 F, 2,000 lb/sq in.	%	D621-48T	0.6 (5)	25	4.2
Heat-distortion temperature, 264 lb/sq in.	deg F	D648-45T	(1)	140	135
66 lb/sq in.	deg F	D648-45T	107	270	300
Miscellaneous					
Index of refraction	n_D	D542-42	1.51	1.35	1.53
Water-absorption	%	D570-42	<0.01	0.0	0.4
Flammability	in./min	D635-44	1.1(3)	nonflammable	self-extinguishing
Specific gravity	.....	D792-48T	0.92	2.1-2.3	1.09
Mold shrinkage	in./in.	.....	0.02-0.05	(1)	0.015
Compression ratio	.....	D392-38	2.1-3.6	(1)	2.2
Resistance to weathering	.....	.....	fair (4)	excellent	good
Basic color	.....	.....	white translucent	light opaque	cream translucent
Resistant to	.....	.....	water, acids, alkalies, oxygenated solvents	all chemicals except molten alkali metals and fluorine	esters, ketones, common solvents, alkalies, weak acids
Not resistant to	.....	.....	chlorinated solvents, aliphatic and aromatic hydrocarbons	molten alkali metals and fluroine	Phenol, formic acid, concentrated mineral acids

Uses

Alathon: Insulation for high-frequency wires, cables and equipment; "potting" compound for encasing coils and other components; storage battery parts; pipe and fittings for water and chemicals; protective coverings; liners for packages

Teflon: Insulating tape for motors, generators and conductors; insulation for high-frequency, high-temperature, high-voltage wires and cables; coaxial cable spacers and connector inserts; non-sticky surfaces

Nylon (FM-3,001): Abrasion-resistant jacket for cables; solvent-resistant (esterlubes) jacket; electric blanket wire; electrical tubing; aircraft hookup wires

Tests have been performed by A.S.T.M. methods unless otherwise indicated. Data shown are average values and should not be used for specifications.

(1) Test not applicable

(2) Thermal conductivity measured by Cenco-Fitch apparatus

(3) Flammability of "Alathon" obtained by A.S.T.M. method D568-43.

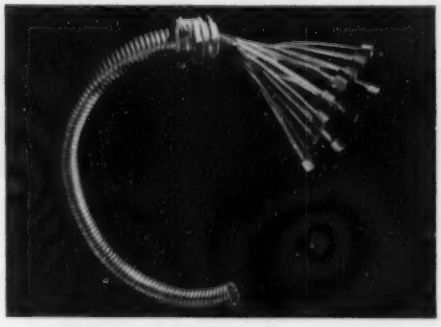
(4) Outdoor durability of black-pigmented "Alathon" is excellent.

(5) Deformation under load for Alathon determined at 100 lb/sq in. (standard for non-rigid plastics).

For the new pneumatic instrumentation

Cabled Tube

The recent tremendous increase in the use of tube instead of wires for instrumentation and control purposes has led to an important new development—cabled tube. This is an armored group of long tubes twisted together to permit bending without distortion. An insulating tape is wrapped over the bundle of tubes to prevent electrolytic action. Then interlocking, flexible galvanized steel armor is applied, like BX. This protects the tubes from injury during shipment, storage, installation, and in service. Standard fittings, boxes and cabinets can be used for junction boxes and terminations. To make it possible to readily identify each tube, one tube in each layer is colored; the position of each tube in each layer in relation to the coded tube

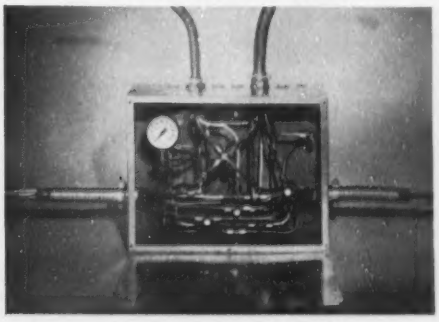


remains the same throughout the length of the cable.

The tubes usually are copper, but aluminum tubes can be used for special purposes. For unusually corrosive situations, a plastic outer sheath can be applied. As many as 19 tubes, ¼" OD, can be cabled, and supplied in lengths up to 1,000 ft.

Showing the construction of Crescent Armored Multitube, made by Crescent Insulated Wire and Cable Co., Trenton 5, N. J., which will supply further information on request.

Since the tubes carry not electricity but air, nitrogen, helium, or a fluid, they are especially attractive in potentially explosive locations, as in refineries and chemical plants. Utilities are also turning decisively to this new cable, while automatic process control (automation) is a rising application.



Revere, as a supplier of tube for this purpose, calls this cabled tube development to your attention as a matter of general and perhaps specific interest. See Revere for copper, aluminum and brass tube and pipe, electric welded steel tube, and lockseam tube. Call the nearest Sales Office.

REVERE

COPPER AND BRASS INCORPORATED

Founded by Paul Revere in 1801

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Mills: Baltimore, Md.; Chicago and Clinton, Ill.; Detroit, Mich.; Los Angeles and Riverside, Calif.; New Bedford, Mass.; Rome, N. Y. Sales Offices in Principal Cities, Distributors Everywhere

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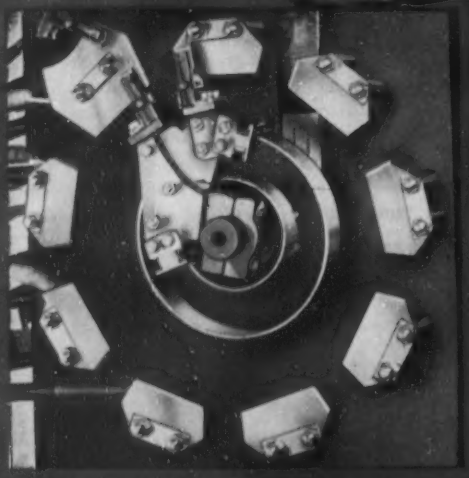
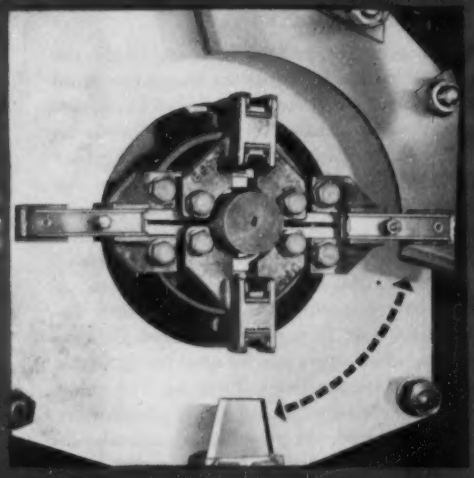
PRACTICAL VERSATILITY



The Tap Selector Switch selects the steppings of the tapped winding to buck or boost the voltage to be supplied by selecting the proper tap terminal. No arcing duty is imposed upon any of the tap selector switch contacts. The Tap Selector Switch maintains full-load operation at any point in its operating cycle. The contact materials are selected to minimize wear from friction.



The Load Transfer Switch breaks all load current, and a reactor is supplied with this switch during opening and closing, keeps arcing to a minimum. Rugged construction affords low current density. Copper tungsten alloy tips minimize deteriorating effects of arcing. Four contacts, instead of two, subjects the switch to but half the arcing duty imposed on other types.

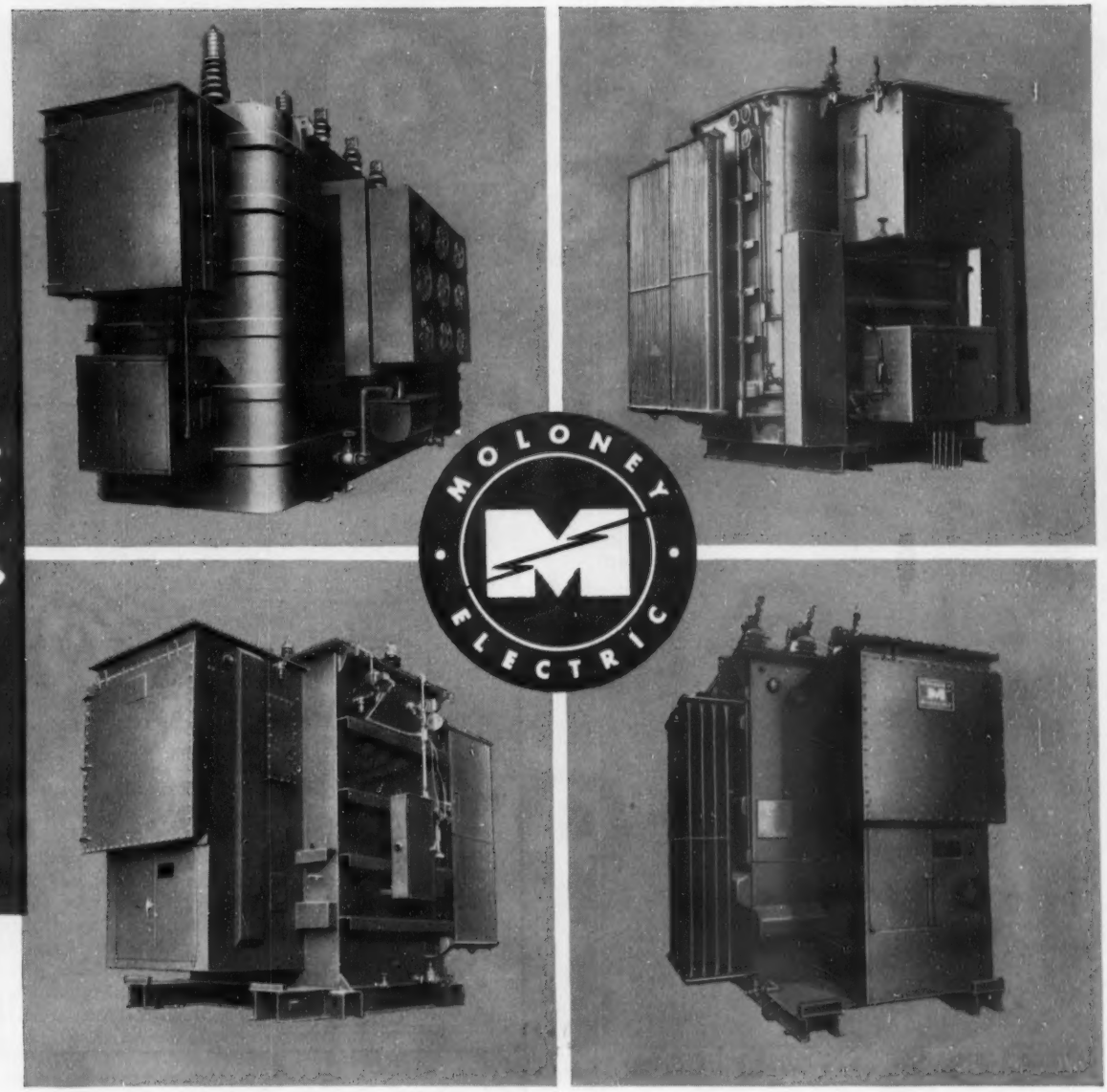
Versatility is a wonderful thing if it is practical. Moloney Underload Tap Changer Equipment combines both practicality and versatility because it is a self-contained mechanism highly flexible for adaptation to many special applications. Unusual operation or installation conditions pose no problems which consultation with our Engineers cannot overcome. The Moloney Underload Tap Changer with the exclusive principle of "reactor by-pass switching" eliminating reactor loss and voltage drop can be integrated into an engineered unit especially suited to efficient operation within *your* system.

ME84-12

MOLONEY ELECTRIC COMPANY

FACTORIES AT ST. LOUIS 20, MISSOURI AND TORONTO, ONTARIO, CANADA

Manufacturers of Power Transformers • Distribution Transformers • Load Ratio Control

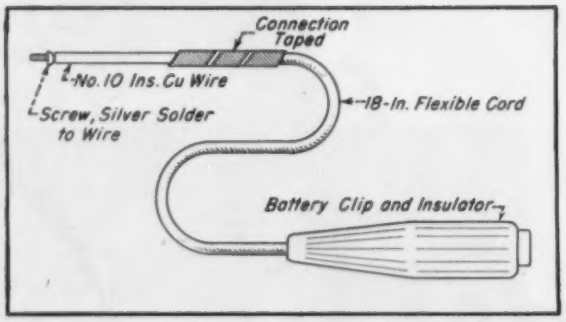


Moloney offers a complete line of regulating equipment which can be had in any Kva and voltage rating. Whatever your system requirements may be—great or small—Moloney Underload Tap Changer Equipment is available to help add efficiency and dependability to your service.

Transformers • Step Voltage Regulators • Unit Substations • Electronic Transformers

Meter-Testing Jumper Avoids Short Circuits

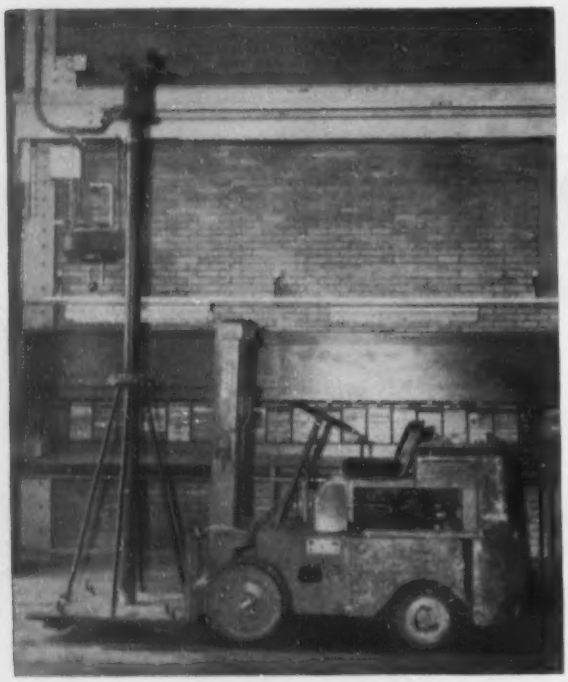
J. G. MESSICK, Meterman A, Ohio Power Co, Lima, Ohio



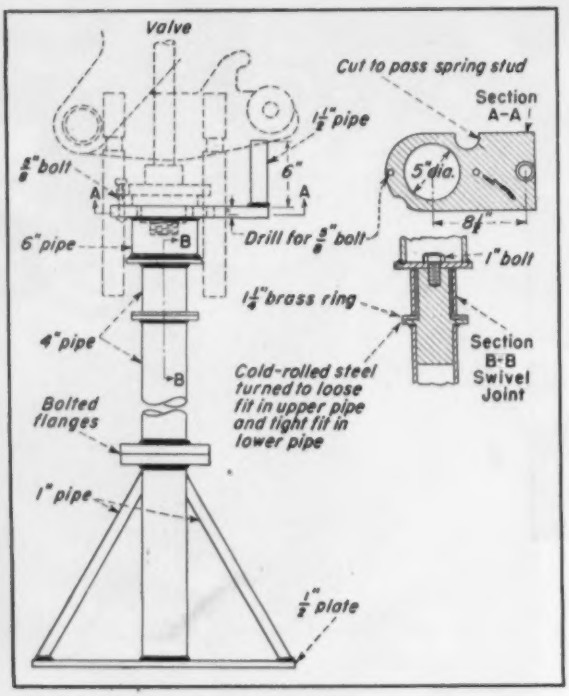
Jumpers, like the one illustrated, prevent accidental short circuits when changing meter connections to parallel potential coils or make a series test of current coils on 3-wire, 3-phase, or other 2-element meters.

Unless precautions are taken, a hazard is present when inserting customary jumpers or leads having spade-type connectors under the binding screws because there is very little clearance between terminals of potential links. A spade connector may also be pulled out by a strain on the jumper and drop to a terminal of opposite polarity. A 240-v short circuit may occur.

Each jumper is provided with a terminal that may be screwed into any meter terminal after the binding screw is removed with a split-bit screw holder. The screw end of the jumper consists of a piece of insulated No. 10 solid-copper wire silver-soldered to the screw terminal and also to an 18-in. insulated flexible lead with a small insulated battery-clip terminal. The entire jumper has synthetic insulation and the soldered joints are covered.



VALVE-HANDLING JIG on fork-lift truck reduced removal and replacement time of lower control valves by 75%



CONTROL VALVE (dotted lines) is shown as it rests on the jig. Swivel joint at top of the jig aids attaching valve to jig

Jig Expedites Handling Lower Control Valves on Turbines

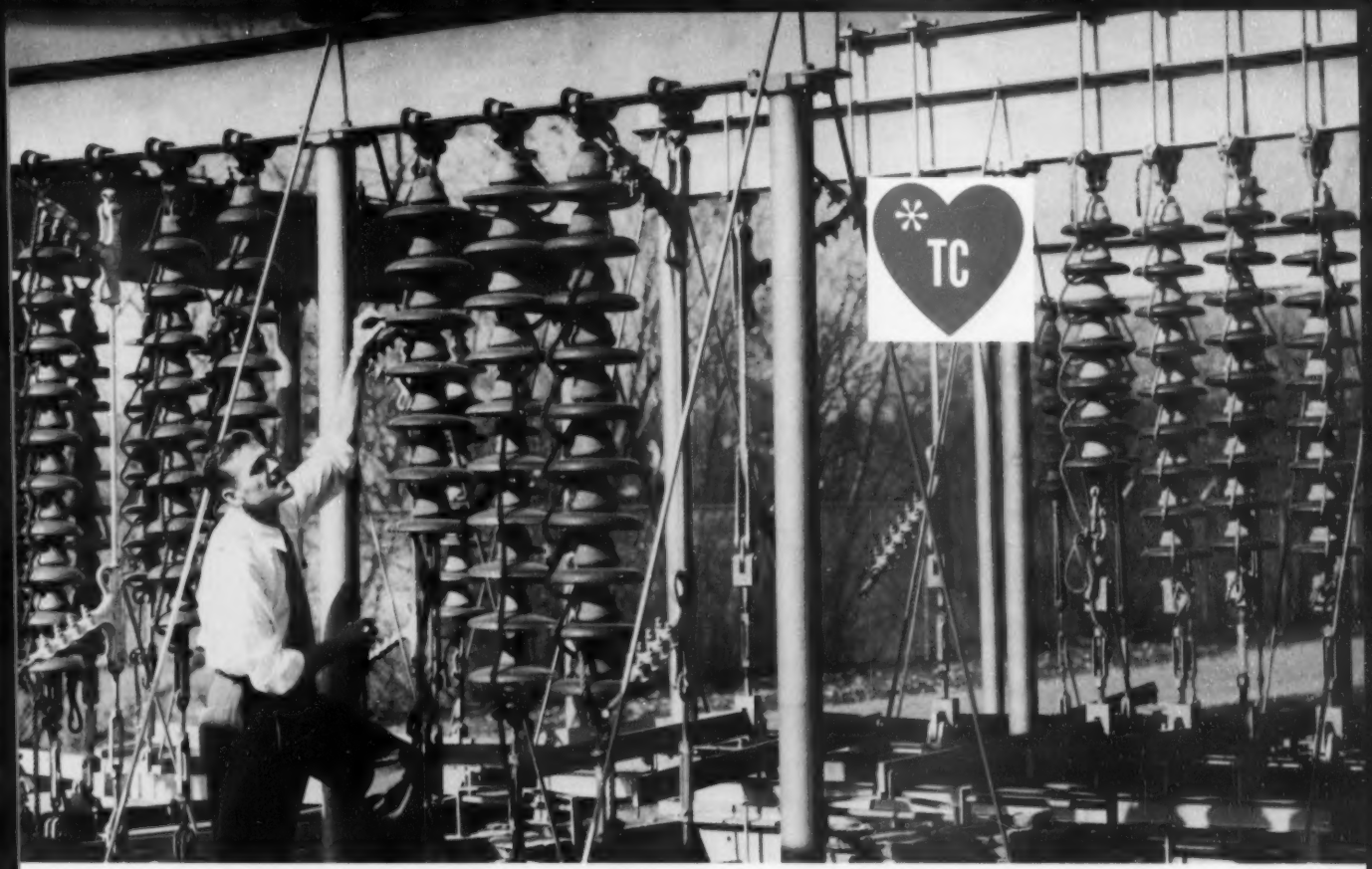
A. L. SMITH, Maintenance Supervisor, Sporn Plant, Central Operating Co, New Haven, W. Va.

A jig mounted on a fork-lift truck reduced manhours 75% for handling the lower control valves during turbine maintenance. Four valves can now be removed and replaced by four men in 1.5 to 2 hr.

The four valves are below the turbine shell and are half of the control valves on each of the four high-pressure turbines at Philip Sporn plant. All valves must be removed periodically (approximately every 8 months) for cleaning the stems and bushings.

Because each valve with its stand weighs about 600 lb

(*Continued on page* 139)



Father Time's Workshop

Only once is an insulator new -- all the rest of its life is spent getting older. To evaluate the effect of age on suspension insulators and hardware, this time-loading test has been in progress many years and is becoming one of the valuable "antiques" in our laboratory. In fact, this is the second set of racks. The first ones failed from exposure and strain, but the insulators on test survived, and are still in robust health in their new place of business.

These test strings of insulators and hardware don't live just ordinary lives. Some receive normal loads; others, varying degrees of overload. Still others have their loads increased periodically until failure eventually occurs. All are watched. Every insulator and every piece of hardware has its life history on file in the laboratory.

Naturally we also run strength tests on new production. We smash a carload of suspension insulators a month that way and send a lot of hardware to the scrap pile. But these accelerated tests are inclined to give only relative answers, and the laboratory is constantly seeking basic facts.

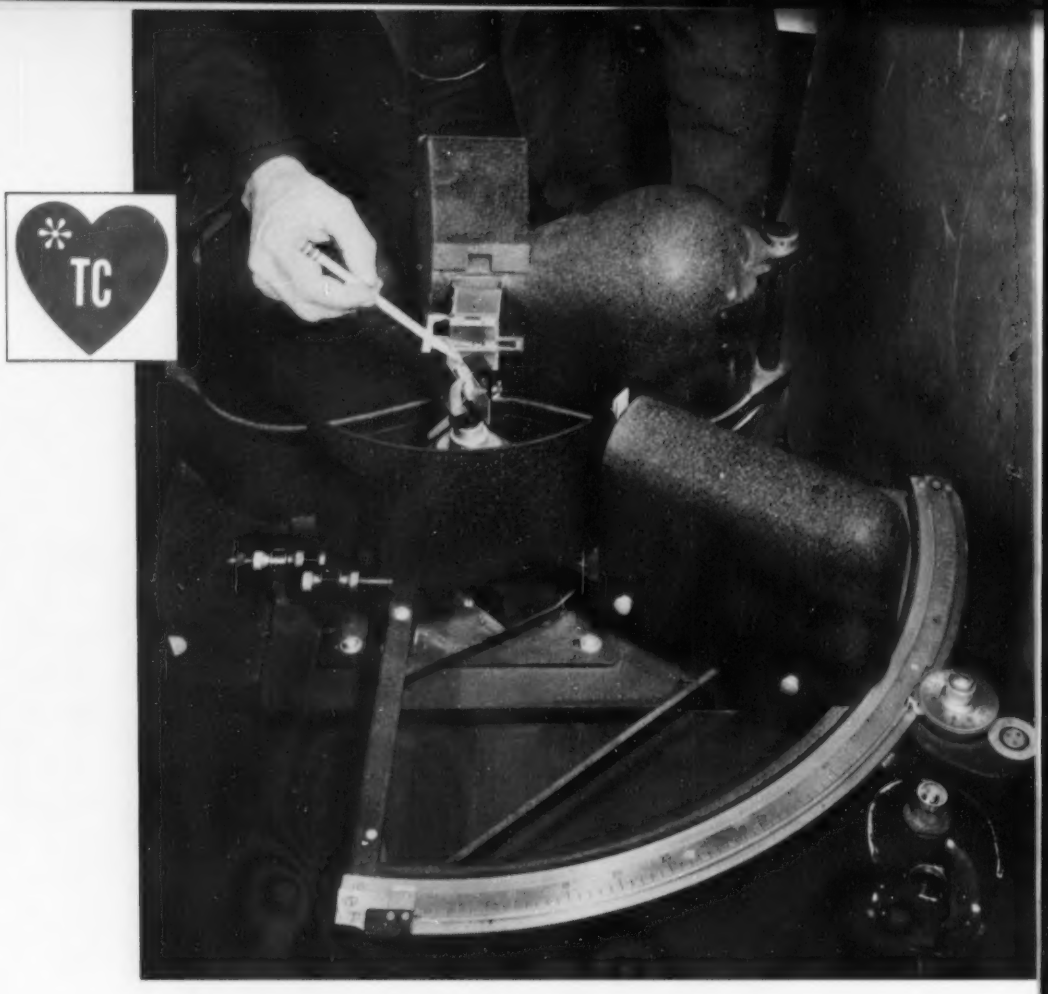
Right while you read this, and tonight while you sleep, and for months and years ad infinitum, these time-loading tests will go on -- typical of the continuity of O-B's testing as well as the conservative, conscientious approach to the problem of making insulators and hardware work together properly, and work as well as we know how -- then really *knowing how!*

Never-ending research going clear back to the "dark ages" of early insulator development, has always been an invisible but very valuable extra ingredient in O-B insulators and hardware -- an ingredient neither defined nor required by Industry Standards. This fact points-up the "investment angle" of such products, where the purchaser takes a standard of minimum quality for granted and begins to evaluate his true money's worth only *beyond the point* where standards leave off. Another phase of intelligent buying takes account of the quality and continuity of O-B's Technical Competence, and recognizes the value of the fine research facilities which are supported by adequate business volume.

OHIO BRASS COMPANY, MANSFIELD, OHIO

In Canada—Canadian Ohio Brass Co., Lt'd., Niagara Falls, Ont.

the heart of every Ohio Brass insulator



Finding Needles in a Chemical Haystack

Clay is decomposed rock. There are infinite varieties of rocks, subject in turn to infinite influences such as moisture, pressure, environment, or bacteria. Out of these countless variables comes a complex product of Nature that has defied all traditional methods of analysis. To be sure, the Chemist can easily find such elements as Silicon. In fact, clay is practically all Silicates of one kind or other, but the big question is, "What kind and how much?" Such a question involves analysis in terms of combined compounds -- complete entities in themselves like Mica or Kaolin -- not elements.

If we don't know such facts about insulator clays, production may be erratic. The old-time pottery once lived from one crisis to the next, all because Mother Nature refuses to "stay put."

For over seven years, and pioneering the work in the Insulator Industry, we have been analyzing clays, quantitatively, in terms of combined compounds. This is done with the Geiger Counter X-Ray Diffractometer. By activation of the Geiger Counter at critical angles, the existence and quantity of each mineral in a specimen can now be "seen" by the technician who once had no effective eyes. No longer are we at the mercy of a fickle product of Nature. Our material, processes, and ultimate product stability are under control.

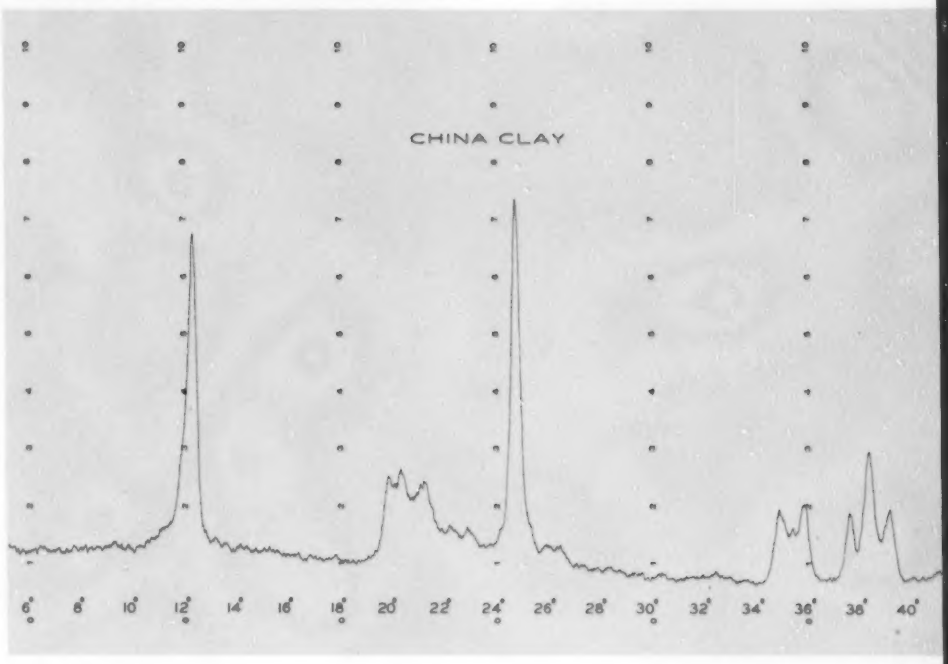
Complicated and costly as the instrument is to perform such tests, the skill of the man must still excel the refinement of the machine. But put such a tool into the hands of a trained technician, and you have that extra ingredient -- Technical Competence -- that isn't *on* O-B insulators, it's *in* them! Obviously, an insulator represents such necessary things as factories, materials, and processes, but O-B goes a step further to include an uncommon degree of knowledge, research, and fine technical facilities which add up to "something *extra* in every package."

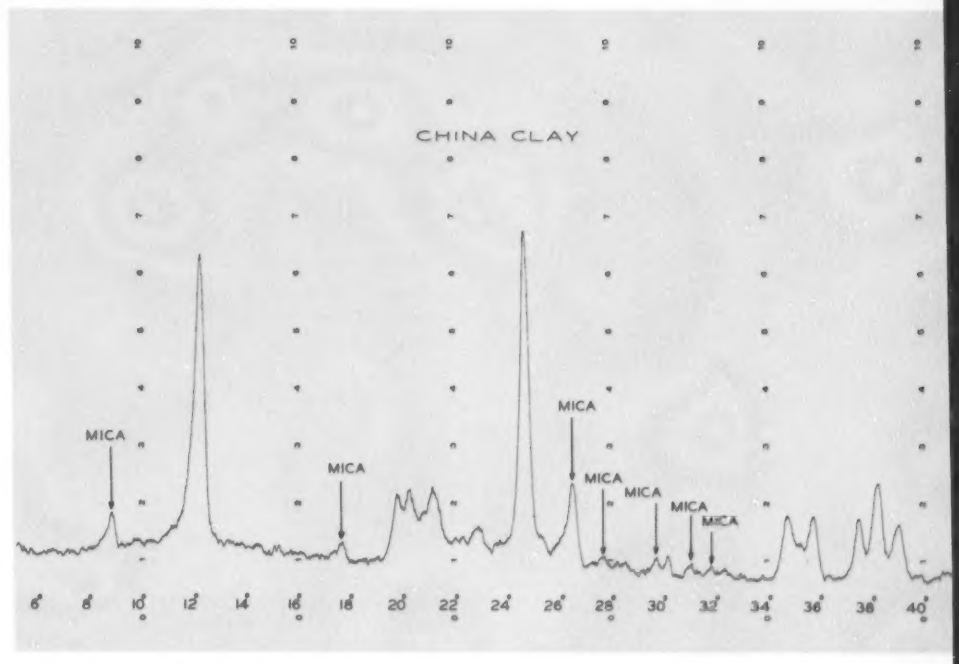
OHIO BRASS COMPANY, MANSFIELD, OHIO

In Canada—Canadian Ohio Brass Co., Lt'd., Niagara Falls, Ont.

Left: Operating mechanism of the Geiger Counter X-Ray Diffractometer. A powerful X-Ray beam emerges from a small aperture and strikes the test specimen on the microscope slide. The specimen and Geiger Counter, contained in the rectangular case, rotate slowly from 90 degrees to zero by electric drive on the large quadrant. (For operation, the curved safety shield in front of the Counter is raised.) By this process the specimen is scanned within a 90-degree arc. Intensity of X-Ray activation of the Geiger Counter is related to a concentration of oriented microscopic structures in the specimen, indicating presence of some specific compound. These varying intensities are recorded on charts shown at the right.

Right: Two charts from the Geiger Counter X-Ray Diffractometer, showing the varying composition of two supposedly similar China Clays. These clays failed to work the same, but no one ever knew exactly why until this advanced research tool made the answer perfectly evident. Either clay could now be used with equal satisfaction in O-B insulators; the only requirement being a minor adjustment in our compounding process. But, without exact knowledge, the erratic nature of such clays would (and did) result in serious difficulties. This is typical of most basic materials entering into electrical porcelain. Here, the presence of "peaks" at specific angles indicates Mica in one specimen whereas no Mica is in the other. All prominent un-identified "peaks" are Kaolin in both samples. The constant flutter at the base of the curves is a combination of background disturbance and the frequent occurrence of Cosmic Rays striking the instrument during operation.





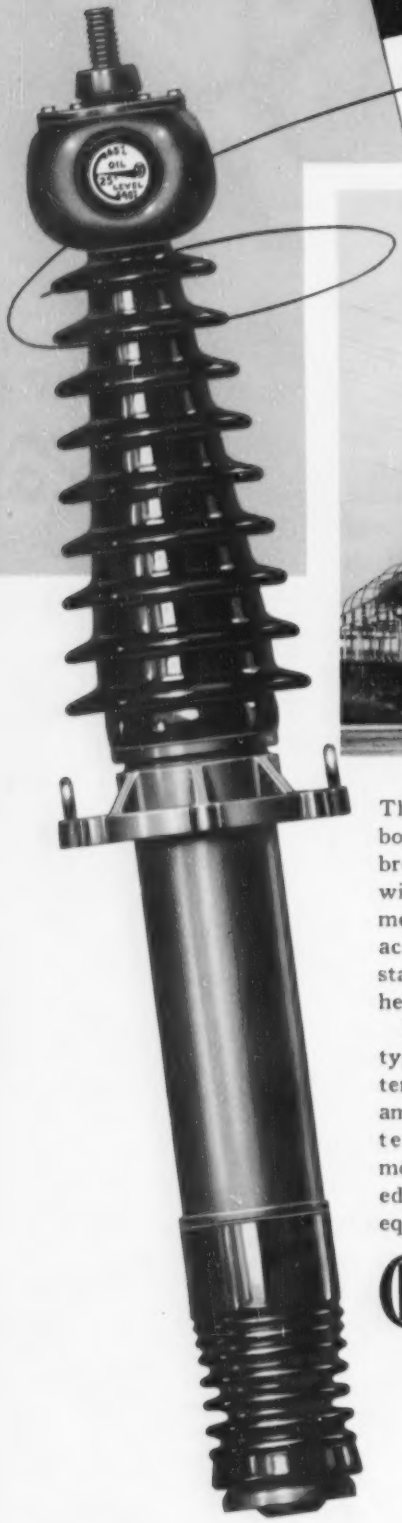
the heart of every *Ohio Brass* insulator

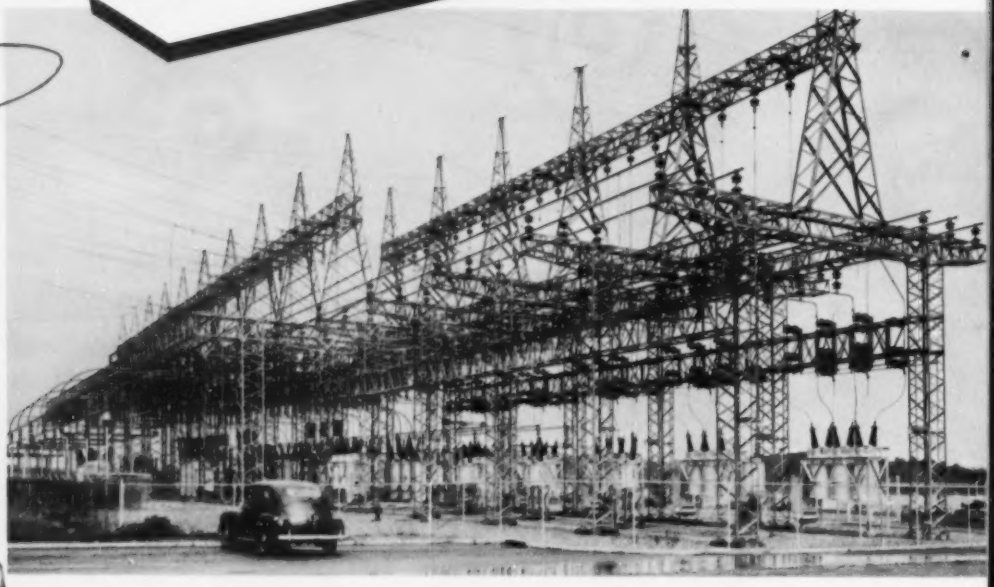
OHIO BRASS COMPANY

BARBERTON DIVISION • BARBERTON, OHIO, U. S. A.

TO:

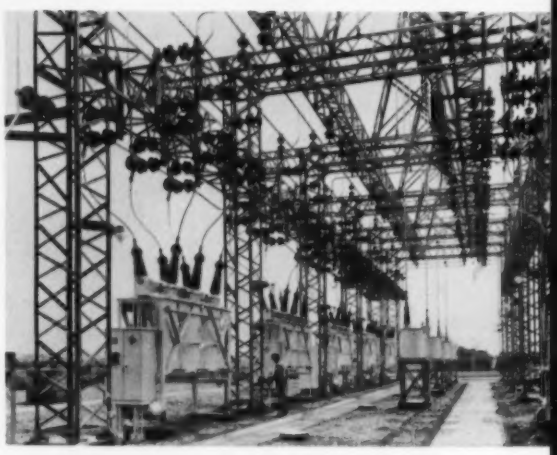
ALLIS-CHALMERS





This Allis-Chalmers installation, both transformers and circuit breakers, is equipped throughout with O-B bushings. Every element of reliability was taken into account in this major switching station serving one of the South's heaviest load centers.

Illustrated in detail is a row of typical breakers whose characteristics are: "Rating, 600-1200 amperes, 69 kv, 1,500,000 kva interrupting capacity; frame-mounted, pneumatically-operated, three-pole, single-throw. All equipped with . . . . ."



(B) BUSHINGS

ONE OF THE FINEST COMPONENTS OF *ANY* CIRCUIT BREAKER

Ohio Brass

MANSFIELD OHIO

4409-H

Valve Jig

(*Continued from page* 134)

and is in a confined space, both removing and replacing of the lower control valves with chain pullers were hazardous tasks. Either operation required four men 6 to 8 hr for four valves.

In the new operation, the valve-lift jig is mounted on a fork-lift by two men in 15 min. Then the fork truck is run under the turbine, and the jig raised until top plate contacts valve stand. The jig's top projection passes between the stem and cam-shaft roller, permitting the valve assembly to rest on the jig's top plate. Adjustment of the jig for proper coupling with the valve stand is aided by the swivel joint. The coupling holds the valve assembly securely in a vertical position so that only one ⅝-in. bolt holds the valve stand to the jig.

After the fork-lift is lowered to the floor, the valve assembly is transferred by a ½-ton "budget" hoist to a 4-wheel cart for transportation to the machine shop. Replacement of the valve is handled in the reverse order.

SIMPLE BARRIER prevents climbing to transformer platform by standing on meter box

Barrier Prevents Climbing on Racks

L. O. BRAUN, Assistant District Engineer, Corpus Christi District, Central Power & Light Co, Corpus Christi, Texas

In a recent accident, two small boys climbed up on the platform of a two-pole transformer rack. This called attention to the ease with which

AT DUSK...

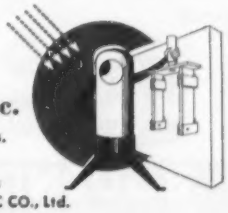
...FISHER-PIERCE PHOTOELECTRIC CONTROL

When street lighting is controlled by Fisher-Pierce, lights *automatically* turn on the instant that natural light intensity falls below a safe level . . . regardless of time of day, season, climate or weather conditions. And, at dawn, lights remain on until natural light is sufficient for safety. No matter how modern your street lighting is, it is not adequate unless the lights are *on whenever natural light is insufficient for safety and protection.*

Fisher-Pierce Photoelectric Controls have been proven by the experience of hundreds of utilities — proven for performance, for technical operating features and for true economy.

When you consider augmenting or modernizing your street lighting, get in touch with Fisher-Pierce. The extensive Fisher-Pierce engineering service organization is at your service.

Write for Bulletin 63300C.



The FISHER-PIERCE CO., Inc.
82 Pearl St., So. Braintree, Boston 85, Mass.

EXPORT: PHILIPS EXPORT CORP. 100 E. 42nd STREET NEW YORK 17, N.Y.

IN CANADA: NORTHERN ELECTRIC CO., Ltd.

Now FIBERGLASS

HOT STICKS

The Makers of Dieck Tools can now supply certain Hot Line Equipment with Fiberglas handles

Based on research to date we can recommend FIBERGLAS on:

- Dieck Wire Tongs
- Dieck Tie Sticks
- Dieck Cutters
- Dieck Universal Poles
- Dieck Hook Sticks
- Dieck Fuse Pullers
- Dieck Clamp Sticks
- Dieck Grounding Sets

Dieck Fiberglas Hot Sticks are:

LIGHTER WEIGHT

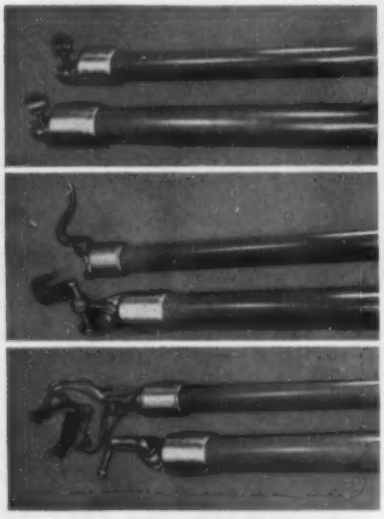
—Approx. 85% the weight of spruce

DEPENDABLE STRENGTH

—Fiberglas has uniform physical properties including high yield and fatigue strength

DEPENDABLE DIELECTRIC

—Increased safety factor due to improved resistance to moisture absorption and dielectric is not sensitive to surface abrasions. All tested 100 KV each foot for 5 minutes.



DIECK TOOLS

Send for technical report "Fiberglas Hot Sticks". Sample piece of Fiberglas Hot Stick available on request.

BODENDIECK TOOL CO.
TAYLORVILLE, ILLINOIS

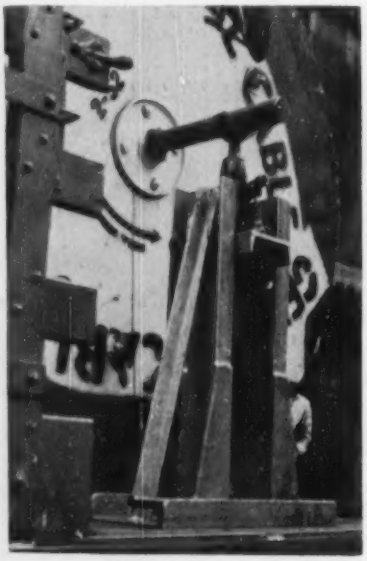
this hazardous area could be reached by standing on the meter box of a secondary metering equipment installed on one rack pole.

There were three possible solutions:

1. Locate the metering equipment elsewhere.
2. Raise the platform so it cannot be reached from the meter box.
3. Install a barrier between meter box and platform.

On the first new installation solution 3 was used and foreman E. E. Mersiosky designed a barrier using four old 4-pin crossarms, two ⅝-in. by 20-in. machine bolts, some ground wire staples, and a roll of barbed wire.

The crossarms were notched and bolted to the pole in the form of a doubled cross just below the platform brace. Barbed wire was stapled on top of the crossarms. A warning sign was nailed to the pole. The other pole in the rack is clear of all footholds for unauthorized climbing so no barrier is installed on it.



ADJUSTABLE FEATURE of jack frame makes it suitable for numerous sizes of reels

Adjustable Jacks Lift Numerous Reel Sizes

W. J. MONTGOMERY, Maintenance Engineer, Underground Division, Cincinnati Gas & Electric Co, Cincinnati

Adjustable hydraulic cable reel jacks, built by Cincinnati Gas & Electric Co for use by the cable pulling

(*Continued on page* 144)

Jrl. Ad ND4-56-461(13)

They dial lower system operating costs

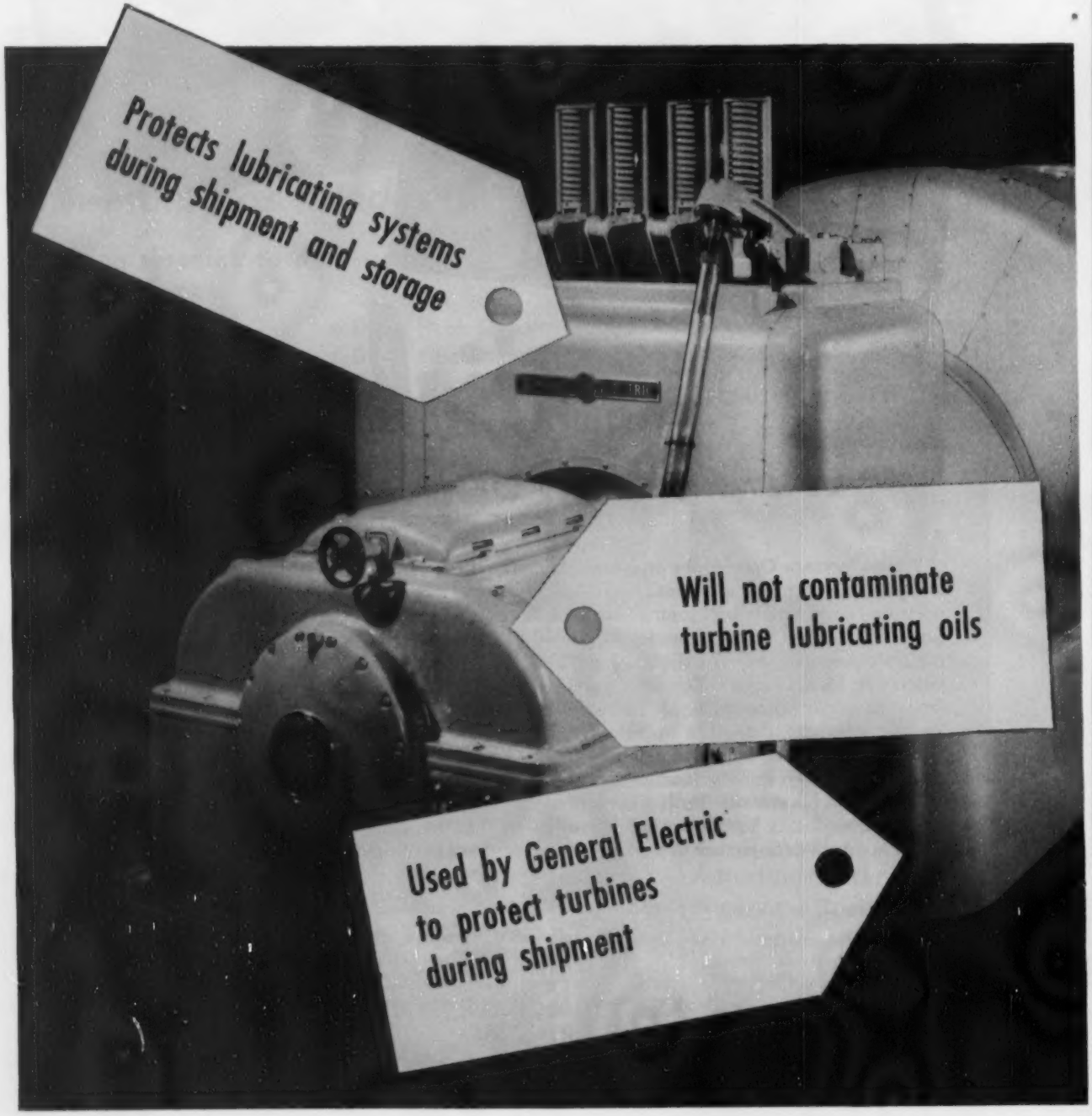
These System Operators on a large Midwestern utility make substantial savings in operating costs simply by "tuning" their L&N Load-Frequency Control Consoles to prevailing system conditions. The System Load Dispatcher in his St. Louis Office (left) loads stations in accordance with an incremental loading schedule; the other operator (right) provides a "vernier" control in a remote generating station by similarly loading the generating units in his station. Both operators rely on L&N Speedomax Telemeters and Recorders for an accurate data-picture of system trends.

Effectiveness of L&N Load-Frequency Control is evidenced by the more than 300 L&N control installations now operating throughout the country. Averaging an installation a month for more than 25 years, L&N engineers have worked hand-in-hand with utility engineers in solving all phases of the control problem. Thus, you are assured that L&N Control will mesh with *all* your requirements.

An L&N Field Engineer is available to discuss your particular needs. You can contact him by writing or wiring Leeds & Northrup Co., 4938 Stenton Avenue, Philadelphia 44, Pa.

announcing

GULF OILCOAT T


Protects lubricating systems during shipment and storage
Will not contaminate turbine lubricating oils
Used by General Electric to protect turbines during shipment

the ideal turbine rust preventive

Now—an effective turbine rust preventive that is non-oil contaminating!

Gulf Oilcoat T—the latest development of Gulf Research Laboratories—in addition to protecting turbine lubricating systems from rust during shipment and storage, will not contaminate turbine lubricating oils. This compatibility with lubricating oils is of paramount importance if your turbine system is flushed with the same oil that is to be used for lubrication.

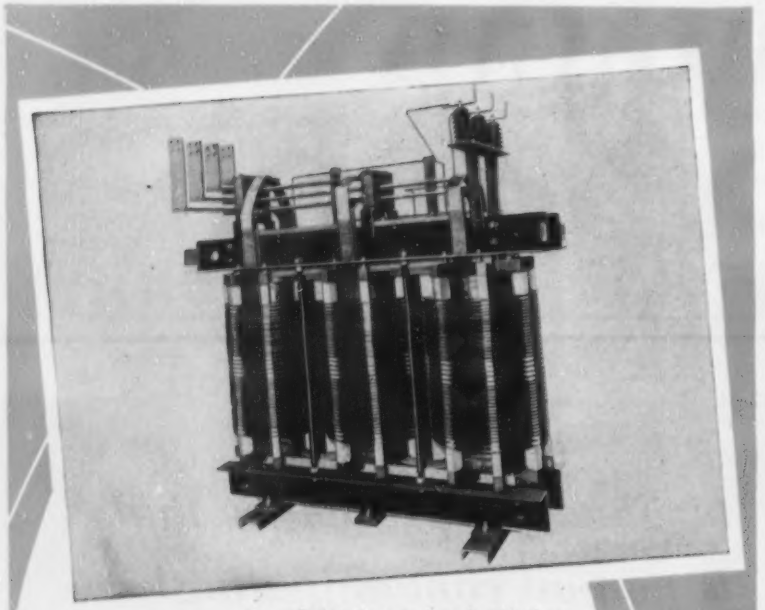
General Electric Company, after comprehensive testing, has established Gulf Oilcoat T as an effective rust preventive and is using it in G-E turbines.

Because of its light viscosity this new product may be sprayed on metal surfaces, or it may be applied by dipping or brushing.

Although developed primarily for protecting turbine lubricating systems, Gulf Oilcoat T also prevents corrosion on other types of machinery during extended shutdowns.

GULF SERVES INDUSTRY

Gulf Oil Corporation
Gulf Refining Company
1822 Gulf Building
Pittsburgh 30, Pa.



Substation equipped with three 1250 KVA single-phase Stockwell transformers.

EVERY STOCKWELL TRANSFORMER is the result of specialized research and sound design. Rigidly controlled materials and modern production facilities are additional guarantees of the quality of our products.

Our field organization and our staff of application engineers at Akron will be glad to help you on all your transformer and substation problems.

STOCKWELL

TRANSFORMERS

DESIGNED FOR YOUR REQUIREMENTS

STOCKWELL TRANSFORMER CORP.

AKRON, OHIO

OIL-FILLED, DRY TYPE, and ASKAREL-FILLED DISTRIBUTION AND POWER TRANSFORMERS

3-1

Jacks

(*Continued from page* 140)

crew, lift reels ranging in size from 36 to 84 in. They consist of a frame and a hydraulic jack that has a steel yoke welded to the ram head.

The frame is made of light-weight aluminum alloy and is mounted on aluminum channel. Between the two vertical members is a movable piece of channel that is held in the desired position by two steel pins. The hydraulic jack is mounted on top of the movable channel and provides quick raising, lowering, and leveling of the cable reel after the channel is properly positioned.

Adjustable jacks have a 5-ton capacity and weigh 71 lb each—46 lb for the frame and 24 lb for the hydraulic jack.

Bracket Welded to Transformer Cuts Installation Cost

R. A. YOUNGMAN, District Engineer, Appalachian Electric Power Co, Fieldale, Va.

Attachment of pole-mounting brackets to 1½-kva transformers has resulted in utilizing the investment in our stock of transformers and in a considerable saving through reduced purchase of new transformers. In addition, this permitted cutting the cost of installing transformers on ridge-iron construction and permitted standard installations of old units with added safety to operating personnel.

Initially our stock of 1½-kva, 6,900-115/230-v, 2-bushing transformers required an adapter for installation. Since these transformers will adequately handle lighting service, and requests continue to be received for them, pole-mounting brackets were fastened, by welding, to the transformer cases.

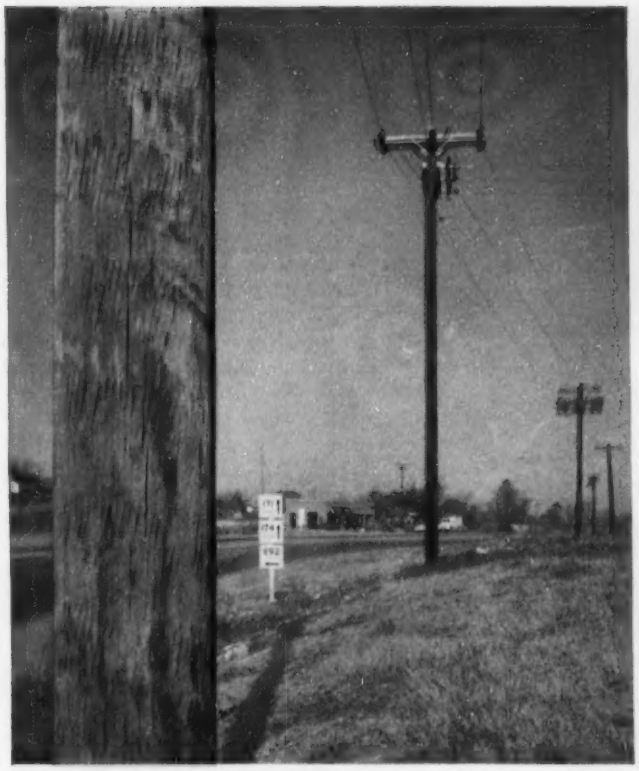
Brackets purchased at $0.70 per pair are attached to the transformer cases by a local welder at $0.75 per transformer, resulting in a total conversion cost of $1.45 for each transformer.

Transformer tanks are patch painted at the same time transformers are renumbered, which makes the repainting cost for transformers extremely small.

DOW

PENTA

the clean preservative for longer pole life



Penta pressure-treated southern pine poles.

Southwestern Bell Telephone makes friends in many Texas cities with its clean poles, pressure-treated with PENTA

THE DOW CHEMICAL COMPANY
Dept. PE-747B
Midland, Michigan

☐ Send me the free booklet, "Pointers on Penta."

☐ Send me a list of PENTA-treating plants.

Name_____

Title_____

Company_____

Address_____

City_____ Zone____ State_____

Longer pole life pays off in replacement dollars saved—*clean* wood treatment pays off in community good will that's difficult to figure in dollars, impossible to buy. But you get both when you specify PENTA* treatment for all the poles you use.

PENTA lengthens the service life of poles and crossarms by providing positive protection against decay and termites. Linemen, too, like to work with *clean* poles.

Over 60 suppliers across the country can furnish you with PENTA-treated poles. Ask your regular supplier about *PENTAchlorophenol, or write THE DOW CHEMICAL COMPANY, Midland, Michigan.

you can depend on DOW CHEMICALS

DOW

Restaurant Show Exhibit Sells Commercial Cooking

Organization, promotion and operation of an "All-Electric Food Service Idea Center" in the Pennsylvania State Restaurant Association exposition and convention is a major annual project of the commercial committee of the Pennsylvania Electric Association. This year, as usual, the Center was an outstanding feature of the Association's show in Pittsburgh, January 18-20. In fact, the officials of the show credit the Center with the attraction of a major portion of the attendance of 5300 persons interested in food service operations. A subcommittee of the PEA committee, composed of Gordon Maize and E. J. Kelly of the Duquesne Light Co and H. S. Orton of the West Penn Power Co, obtained the support and participation of major manufacturers of electrical equipment and devised excellent promotional and display measures.

Pittsburgh's "All-Electric Center" was different from and more comprehensive in showmanship than previous shows. The exhibits occupied all of the 25 spaces of the Fort Duquesne Room of the William Penn hotel, permitting the inclusion of manufacturers of equipment other than just electric cooking—air conditioning, ventilation, icemaking, and lighting.

A colorful circus motif was used for the decoration of the exhibit area. Entrances to the "All-Electric Center" were made through portals flashing "The Greatest Show on Earth, Of Course, It's Electric!"

Bulb Campaign Hits 221% of Quota

TOM LYNN, Southwestern Public Service Co, Amarillo, Texas

Over 21% of the 115,992 residential customers of the Southwestern Public Service Co purchased 171.052 lamps, totalling 15,394,680 watts, in the company's first try at a full-scale lamp promotion last fall. Called the "Reddy Kilowatt Balanced Budget Bonus Bag" campaign, the promotion featured a package of three each of 60- and 100-watt bulbs with a bonus of one 150-watt. The package was sold for $1.14, the price of the six smaller lamps.

The campaign was conducted throughout the company's service area with all distributors and dealers urged to participate. Lamps sold by dealers were purchased from usual suppliers; the company furnished each distributor and dealer a brochure of information on the campaign; and to dealers, bags, banners, coupons, and other advertising and display materials at no charge, and arranged for a selection of 22 prizes for dealers with average retail value of $7.50. Each of 35 bags of lamps sold by a dealer made him eligible for a prize, and for each additional 35 bags of lamps sold, one additional prize was earned. Employees of the company also sold lamps and prizes were earned on a merit point system.

The lighting recipe booklet, "See Your Home in a New Light" was distributed with each bag of lamps until the supply was exhausted. Then a postcard was used whereby customers could still obtain the booklet, and 223 cards were returned requesting it.

Results were most gratifying with practically all distributors giving the program sales emphasis, and nearly 800 dealers selling bonus bags of lamps. One hundred seventeen dealers earned 273 prizes, and 211 company employees earned prizes.

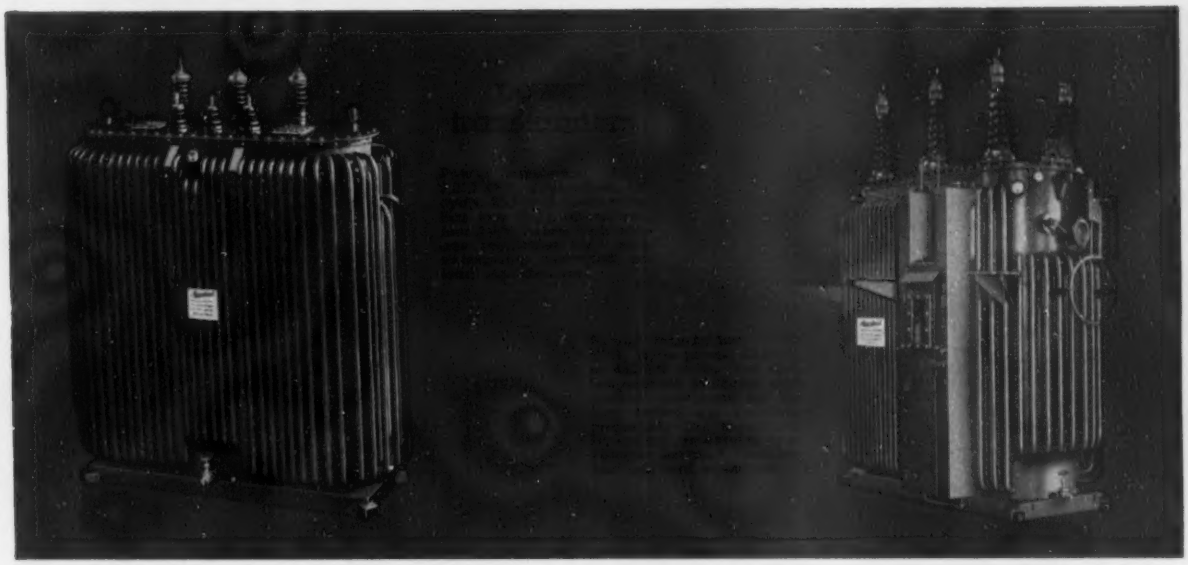
A total of 24,436 bonus bags were sold by dealers and company employees. This was 221% of the quota of 11,037 which had been set.

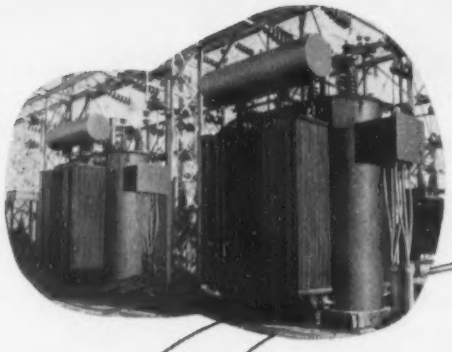
Union Electric Tells Dealers 1954 Sales Plans

Light's Diamond Jubilee was the keynote of Union Electric's 1954 Annual Sales Rally in January. Nearly 1,500 electrical appliance distributors and dealers from the St. Louis area attended the dinner meeting for a dramatic preview of Union Electric's advertising and sales promotion plans for the year.

The Diamond Jubilee motif was reflected in the stage setting, the keynote talk by M. E. Skinner, vice president of sales, and in the year's sales program outlined in talks, skits, slide presentations and song during the evening's program.

Chief speaker on the program was Ralph E. Moody, executive vice president and general manager of Union Electric. He emphasized the importance of high users of electricity, citing many cases of Union Electric customers using two and three times more electricity in their homes than the





When dependability is a factor...

● Dependability in a transformer to you means trouble-free performance and long service life. To us, this means dependable construction.

For example, at STANDARD . . .

Tanks are built of rust-resisting steel, arc welded seams and tested under pressure. Liberal clearances are allowed from the windings and leads to tank and cover.

On the outside . . . attractive, long-wearing finishes with a primer coat and two finish coats of blue-gray enamel . . . on the inside, a lining of red oxide.

Covers are carefully and accurately fitted.

Tap changers and accessories efficiently placed with a specially designed tap changer switch.

These are just a few of the construction factors which STANDARD builds into Power Transformers. Look to STANDARD when you want dependability.

Everything Points To...

WRITE FOR BULLETIN CL-50

Tells the story with words and pictures of STANDARD'S complete line of transformers, and how they perform for every class of service . . . on the job.

Standard

THE STANDARD TRANSFORMER COMPANY

Trade Mark ®

WARREN, OHIO

REPRESENTATIVES IN PRINCIPAL CITIES

Company's average residential annual average load of 2,400 kilowatts. The future lies, he stated, in bringing up the average to the level of the high-use customers cited. "Nothing but pure unadulterated selling is needed to bring our system-wide average up to the average of the families just cited," he said.

After Skinner's keynote talk, the program was turned over to Robert L. Coe, residential sales manager, who introduced the various speakers, skits and presentations. Covered in the program were the various advertising and promotional plans for electric range, clothes dryer, water heater, dishwasher and home freezer sales. Walter G. Heren, director of advertising and public relations, outlined the advertising programs planned for each of these promotions.

At the meeting six sales contests for distribution, dealers and appliance salesmen were announced for 1954. They are: a special contest in connection with the February electric clothes dryer campaign, the fourth annual "Name Your Quota" water heater sales contest in April and May, home freezer sales competition in July, the annual electric range contest in the October and November and the Reddy Kilowatt electric range and water heater sales improvement awards.

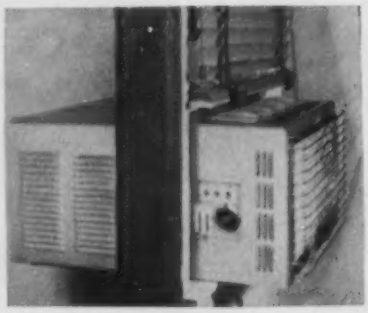
How to Light a Garden

To encourage householders to make their gardens as attractive by night as by day is the purpose of a new 48-page illustrated booklet called "Garden Lighting" which has just been issued.

A complete reference on the subject, the booklet was written by Edythe Polster, author of many articles on lighting and better living, and Myrtle Fahsbender, director of residential lighting for the Westinghouse Lamp Division, a leading authority in home illumination. The booklet contains 28 photographs of distinctively-lighted gardens and 43 sketches of garden fixtures by Janet Schirn.

Included is a do-it-yourself section, with practical suggestions for constructing homemade housings, as well as a guide to ready-made lighting equipment available for a multitude of specific needs. The booklet, which sells for $1.00 a copy, may be obtained by writing Residential Lighting Department of Westinghouse Lamp Division, Bloomfield, N. J.

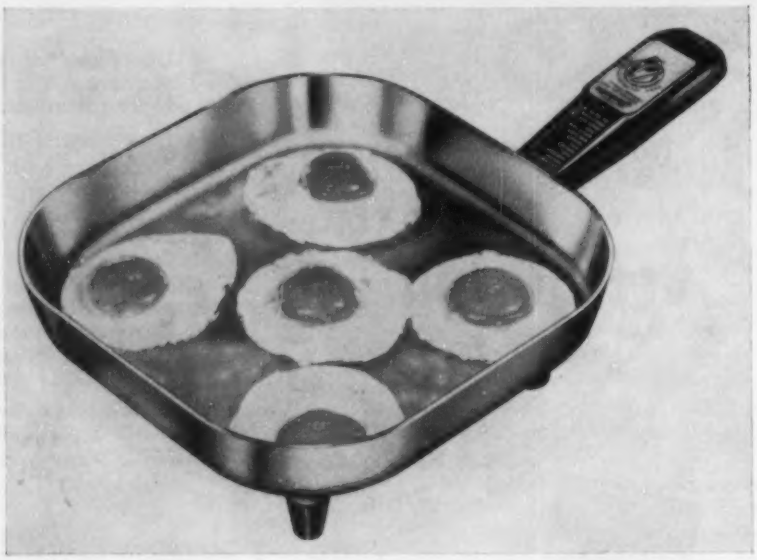
Combines Cooling and Radiant Heating



Designed to keep a room cool or warm as desired, an air-conditioning unit with a glass radiant heat panel is being introduced by the Electriglas Corp of Bergenfield, N. J. Bearing the trade name of "Electriglas Twin-Features," the new dual-purpose unit, for wall mounting or window insertion, is the first of its kind to supply radiant heat. The source is a glass panel covering the unit's face. Protected by a decorative grille, the panel attains a maximum temperature of 440 deg with a 1,500-w consumption.

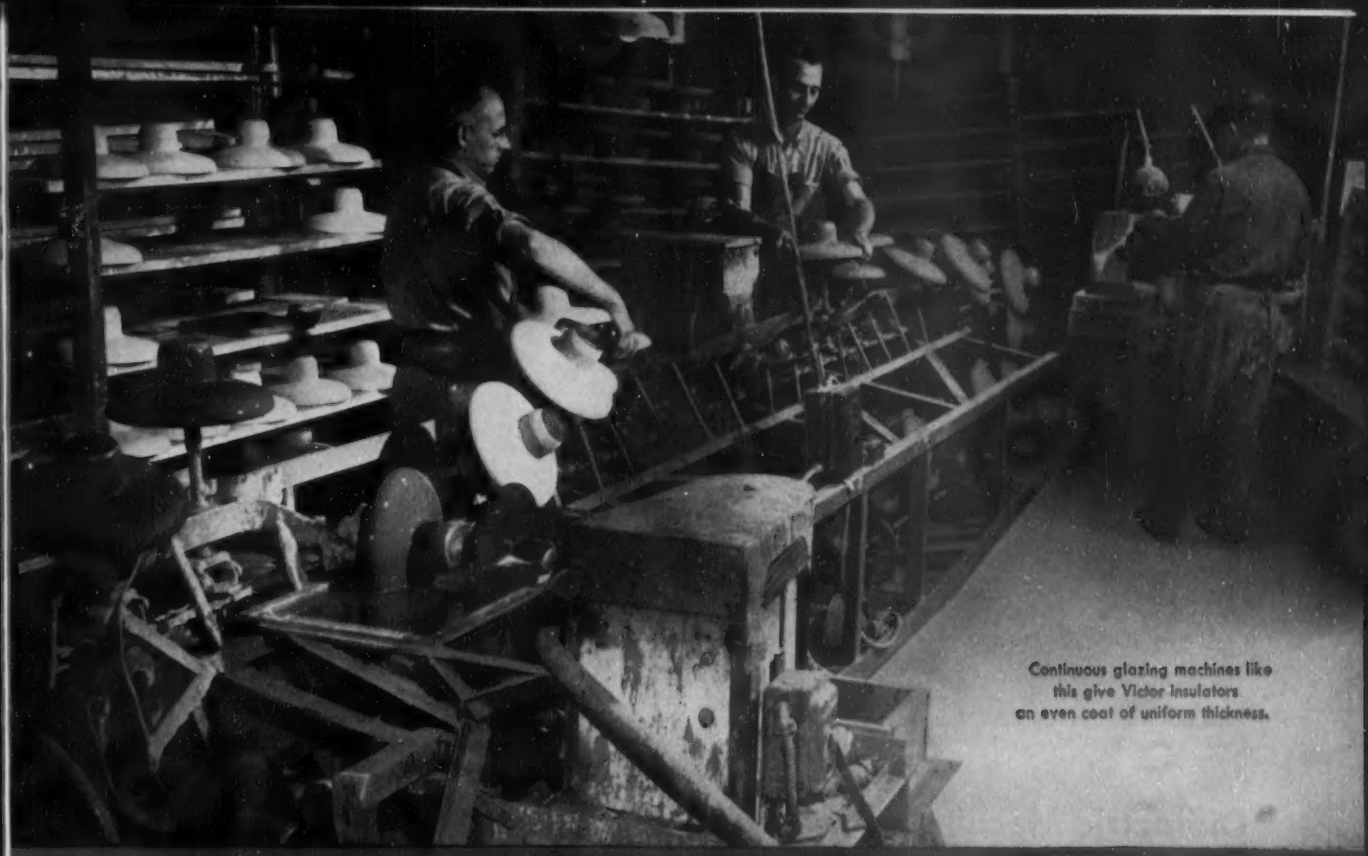
The air-conditioner utilizes a ¾-ton hermetically sealed compressor. Both it and the panel, operating on 120 volts, 60-cycle AC, are controlled by a series of three switches and a thermostat mounted on one side of the unit. The thermostat, governing both heating and cooling, will maintain a year-round constant temperature at whatever point desired. The unit is 26 inches wide, 15 inches high, and projects into the room 9½ inches from the window frame.

Among the many uses seen for the unit is installation in a room added to a house or in an area lacking heating facilities. Extension of an already installed heating system to such areas not only is expensive but may add a load beyond the system's designed capacity, which could result in unsatisfactory operation through the whole house. According to a current promotional program of the Gypsum Association there is a potential add-a-room market of 7 million homes.



Redivivus, the Electric Frying Pan

A new version of an early-day electrical appliance has just been introduced on the market. It's an automatic, controlled heat "Frypan," manufactured by Sunbeam Corporation, Chicago, Illinois. According to the manufacturer, never before has there been an appliance that gives the user the perfect temperatures for cooking on top of the stove just like she gets in the oven. An easy-to-see "fry-guide" on the handle gives recommended frying temperatures. The square design allows frying larger quantities of foods than in a round pan. The entire pan can be immersed in water up to the control knob for washing.



Continuous glazing machines like this give Victor insulators an even coat of uniform thickness.

Another Reason Why—

VICTOR Makes Better Insulators

WE USE AUTOMATIC GLAZING MACHINES

PERFECTION of glaze makes an insulator self-cleaning, gives it higher mechanical strength and greater resistance to thermal variations.

By designing and building its own automatic machines, Victor gives you this glazing perfection. Each insulator is thoroughly and evenly coated with glaze. Timing is accurately controlled for maximum penetration at the interface of the insulator body and the glaze.

That's why Victor gives you smooth, perfectly glazed insulators that stand up under the most severe conditions of service . . . that cut maintenance and replacement costs to a minimum. For the full story, send for our free booklet, "The Story of Victor and Purified Porcelain."

VICTOR NO. 900 SUSPENSION INSULATOR

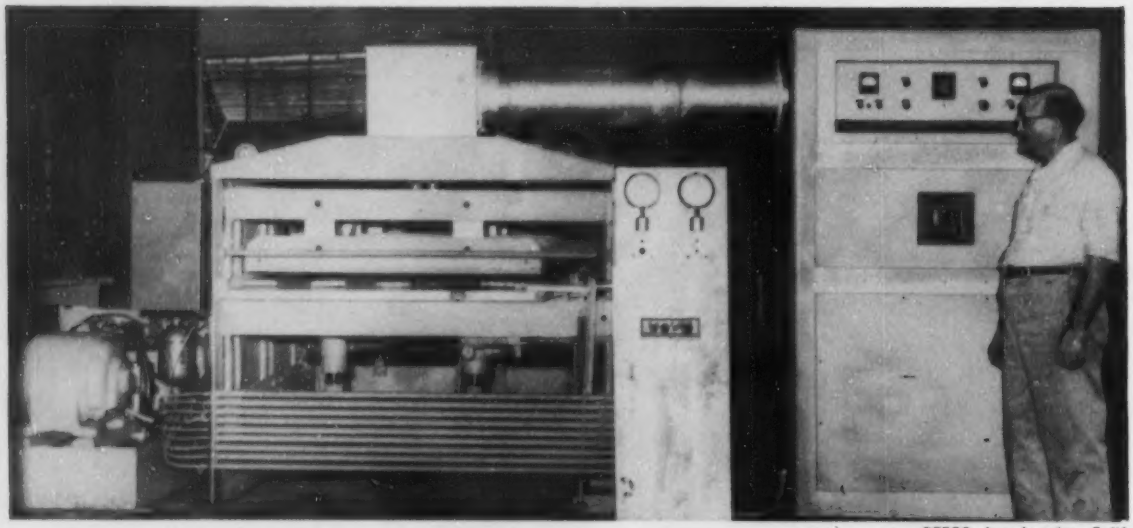
Specify

VICTOR PURIFIED PORCELAIN INSULATORS

VICTOR INSULATORS, INC., VICTOR, N. Y.

Low and High Voltage Pintypes • Suspensions • Guy Strains • Spools • Switch and Bus Insulators

• Custom Designed Porcelain • Insulator Hardware



PEECO, Los Angeles, Calif.

EDGE GLUING PRESS with dielectric heat cures glue under pressure in 15-20 sec. Automatic machine handles panels of wood pieces up to 48-in. wide and 4-in. thick. Maximum capacity is 2,800 fbm an hour. Methods previously used were not so efficient and took up to 24 hr

Dielectric Machine Cures Glue Automatically

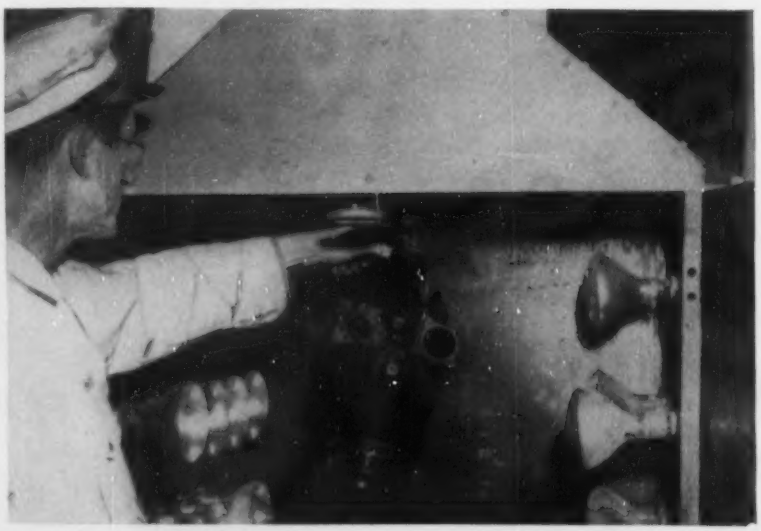
L. B. Reed, Industrial Heating Consultant, Business Agent's Division, Dept. of Water & Power, City of Los Angeles, Calif.

A unique completely automatic dielectric heating machine at the Weyerhaeuser Timber Co, Tacoma, Washington, loads, presses and 100% cures the glue on wood panels consisting of pieces 1-in. thick, 3-in. wide and 7-ft long in 15 to 20 sec. By edge gluing small pieces of wood, this machine produces large planks of high quality. Pieces up to 48-in. wide and 4-in. thick can be handled. Maximum capacity is 2,800 fbm an hour.

With the "steam platen" glue curing method, the lumber is held by the platens about ½ min and cures glue 1/16 in. deep on both sides. The glue finishes curing in about 4 hr. With the old "cold clamping" method, 24 hr is required and no heat is applied. Glue curing by these two methods is indifferent, while with the dielectric method, 100% curing is effected under pressure in 15 to 20 sec. The cold clamp method requires 10 times the manpower required by the steam and dielectric methods. However, the dielectric method produces a far better quality gluing job than the other two methods.

Oven Cuts Drying Time of Engine Parts

Drying painted parts of overhauled engines, instrument panels, etc. in a homemade steel baking oven has reduced the time required to from 20 to 30 min at Southern Airways Co, Municipal Airport, Atlanta, Georgia. Formerly, at least 24 hr was required to air-dry these parts. In addition, the baked finish is more durable and has



ENGINE PARTS are dried after painting in from 20 to 30 min with homemade infrared oven. Finish looks better and is more durable

Roeplastic control cable—

THE ONLY CONTROL CABLE WITH CIRCUITS *POSITIVELY* IDENTIFIED

THIS NEW Roebling ROEPLASTIC Control Cable makes circuit identification quick and certain for the first time in history. A workman can't go wrong even if he's color blind. Here's why:

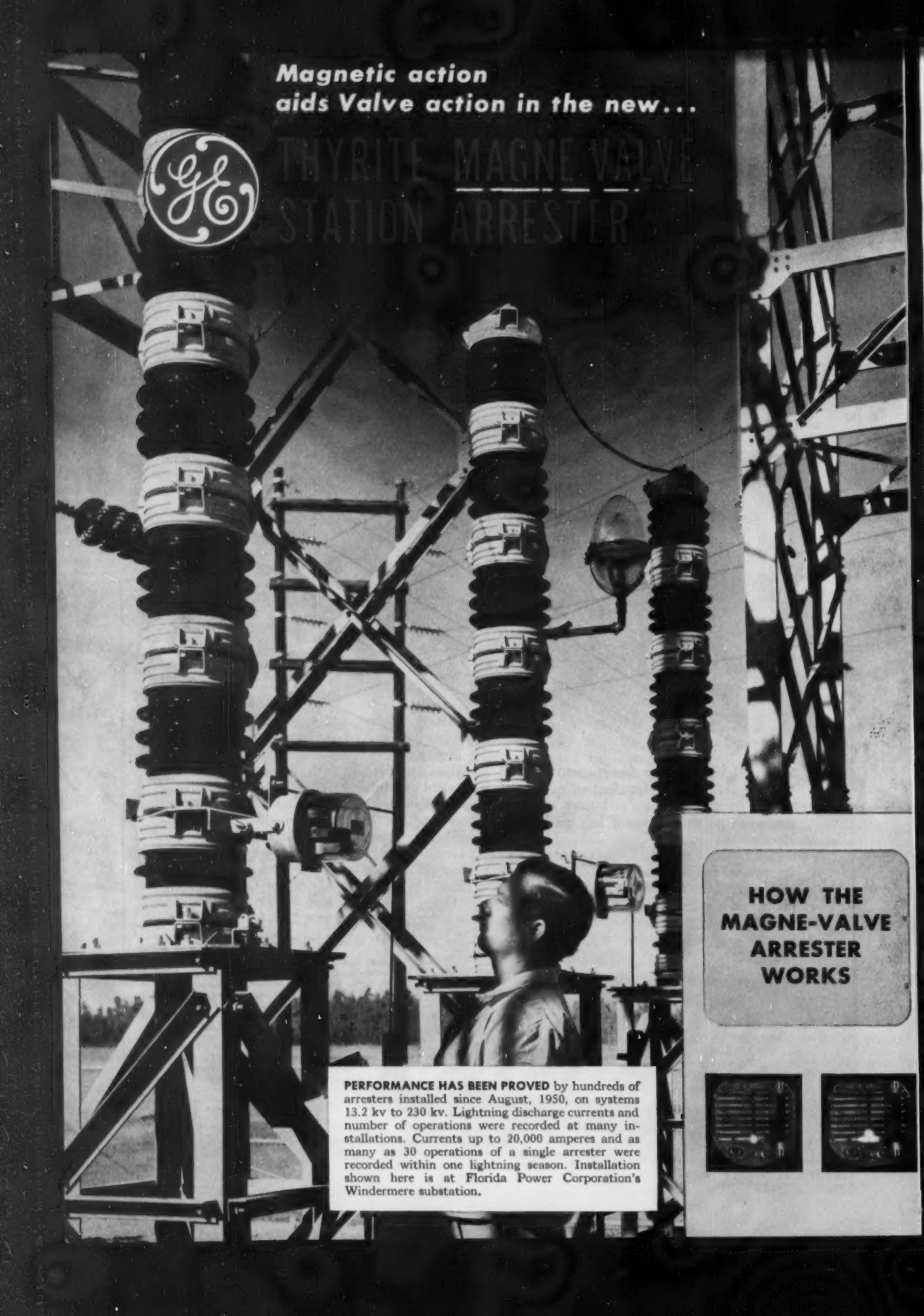
In ROEPLASTIC Control Cable, each conductor is identified from end to end by both its IPCEA code color name and its individual number by means of an indelible printing against a strongly contrasting background. The printing is permanent; it cannot fade or rub off... identification is always positive whether plans show circuits by color code or by numerals.

Roebling ROEPLASTIC Control and Signal Cables are ideal for such purposes as remote control of motors, switch gear, automatic machinery, etc.... for traffic light control, relay, metering and supervisory circuits. They are made in constructions, types of insulations and over-all sheaths to meet every specific requirement. Write for technical data... and order ROEPLASTIC Control and Signal Cables from your Roebling distributor. John A. Roebling's Sons Corporation, Trenton 2, N. J.

Subsidiary of The Colorado Fuel and Iron Corporation

ROEBLING

ATLANTA, 934 AVON AVE • BOSTON, 51 SLEEPER ST & 8 PITTSBURGH ST • CHICAGO, 5525 W. ROOSEVELT RD • CINCINNATI, 3253 FREDONIA AVE • CLEVELAND, 13228 LAKEWOOD HEIGHTS BLVD • DENVER, 4801 JACKSON ST. • DETROIT, 915 FISHER BLDG • HOUSTON, 6510 NAVIGATION BLVD • LOS ANGELES, 5340 E. HARBOR ST • NEW YORK, 19 RECTOR ST • ODESSA, TEXAS, 1920 E. 2ND ST • PHILADELPHIA, 230 VINE ST • ROCHESTER, 1 FLINT ST • SAN FRANCISCO, 1740 17TH ST • SEATTLE, 900 1ST AVE S. • ST. LOUIS, 3001 DELMAR BLVD • TULSA, 32 N. CHEYENNE ST • EXPORT SALES OFFICE, TRENTON 2, NEW JERSEY


Magnetic action
aids Valve action in the new...
THYRITE MAGNE-VALVE
STATION ARRESTER
HOW THE MAGNE-VALVE ARRESTER WORKS
PERFORMANCE HAS BEEN PROVED by hundreds of arresters installed since August, 1950, on systems 13.2 kv to 230 kv. Lightning discharge currents and number of operations were recorded at many installations. Currents up to 20,000 amperes and as many as 30 operations of a single arrester were recorded within one lightning season. Installation shown here is at Florida Power Corporation's Windermere substation.

20% better protective level
3 times greater endurance

The new Thyrite* Magne-valve arrester is a major advance in reliability of co-ordinated protection of station apparatus. Let's appraise it!

FOR APPARATUS HAVING STANDARD BIL'S—

You get an unprecedented margin of protection that assures co-ordinated protection for many times higher stroke currents—even 100,000 amperes. This super-protection is especially valuable where lines or substations are not shielded or where practicable shielding may not be infallible.

You get an extra margin of protection which tends to offset adverse effects of separation between arrester and apparatus—enabling co-ordinated protection to apparatus at greater distances from the arrester.

FOR H-V APPARATUS HAVING REDUCED INSULATION—

You get as large a margin of safety in protecting 1-step reduced BIL insulation as was heretofore possible only when protecting full insulation (standard BIL). Hence, the new arrester enables a more positive approach toward reduced insulation and resulting tremendous savings in apparatus investments.

FOR DRY-TYPE TRANSFORMERS—

You get a good margin of protection—heretofore limited. Although oil- or askarel-filled transformers are distinctly preferable for connection to lines exposed to lightning, the decidedly lower impulse strength of dry-type transformers can now be better protected.

FOR APPARATUS HAVING DEPRECIATED INSULATION—

You get more positive protection—to preserve and greatly extend the operating life of old but important apparatus.

**Reg. Trademark of General Electric Co.*

FOR AC ROTATING MACHINES—

You get as good margin of protection to even impedance-grounded neutral rotating machines using ungrounded-neutral 100% rating arresters, as was heretofore practicable with only grounded-neutral 80% rating arrester. And for grounded-neutral machines, you can now limit the lightning stresses to 80% of the machine's 1-minute hi-pot test level. Both are important achievements for better protection of generators, synchronous condensers, and motors, alike.

FOR ALL THESE APPLICATIONS—

You get full-fledged uncompromised ***station*** arrester protection—6-inch diameter low-resistance Thyrite valve-disk with exclusive integrally fired ceramic insulating collar, the most efficient valve element ever offered.

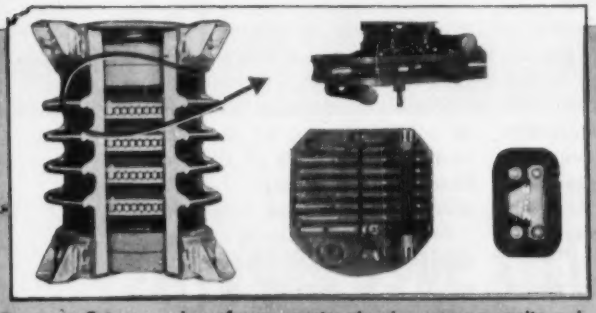
You get straight-in-line, low-resistance discharge path—28 sq. inches of cross-sectional area, with no tortuous up-and-down impedance.

You get over 3 times greater discharge capacity and thermal endurance—plenty of "guts" for withstanding high lightning currents, multiple lightning strokes, long-duration lightning discharges and severe switching surges.

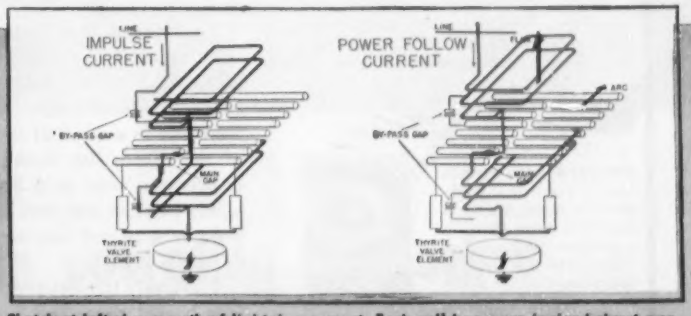
You get greater endurance now—and it protects you for future increasing discharge duty on station arresters attending trends to higher voltage lines, longer lines, greater lengths of cables, and more shunt capacitors, which increase the stored CE^2 energy in switching surges.

For more information about this new station arrester, get in touch with your nearest G-E Apparatus Sales Office or write for Bulletin GEA-1304 to Section 432-5, General Electric Company, Schenectady 5, N. Y.

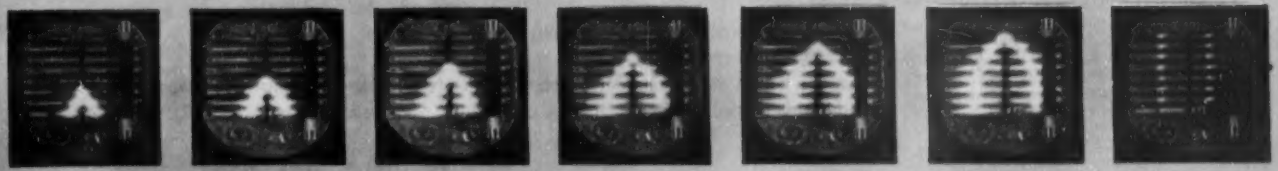
GENERAL ELECTRIC



Cut-away view of new arrester showing new gap units and their components. Gap unit (circled in red) consists of 7 pairs of adjacent gap electrodes within the field of 2 magnetic coils. One pair of electrodes constitutes main gap which controls impulse sparkover sensitivity; other pairs of electrodes form multigap path for arc-interruption of the power follow-current.



Sketch at left shows path of lightning current. Each coil has a pre-ionized shunt gap that by-passes lightning current to the discharge path shown in red. Sketch at right shows path of 60-cycle power follow-current. After lightning sparkover, the 60-cycle power follow-current flows through the coils, as shown in red, creating magnetic flux. Arrows indicate direction of magnetic flux and blowout motion of arc, which motion is the same for either polarity of the 60-cycle follow-current wave.

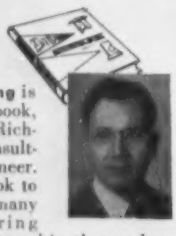


Film strip (from high-speed movies) shows how magnetic force sweeps power follow-current arc progressively from main gap (see extreme left) to as many as 14 multigaps in series (see second from extreme right) for efficient arc-interruption in less than a half cycle. The arc-path moves so rapidly that even hundreds of interrupting operations cause no harmful scarring or burning of gap electrodes.

what's NEW in Engineering

A new concrete curing process, being tested by the New Jersey Highway Department, may speed the building of bridges and viaducts. It permits the wooden forms supporting wet concrete to be removed in 60 hours instead of the usual 14 days. After the concrete is poured into the forms, 3-foot square mats are laid on top and vacuum hoses are used to draw off excess water. This cures the concrete in a fraction of the time formerly required.

A sinking plant, and what to do about it, was one unusual assignment given Kaiser Engineers. A large area of land on which the tidewater plant was located had sunk six feet in twelve years; the dock loading area had become unusable at high tide. To solve the problem, Kaiser Engineers re-designed the dock area to increase its height and make it serve as a coffer dam to keep the water from affecting the round-the-clock operations of the mill. Tight construction scheduling was a must because of ship traffic and high tides.

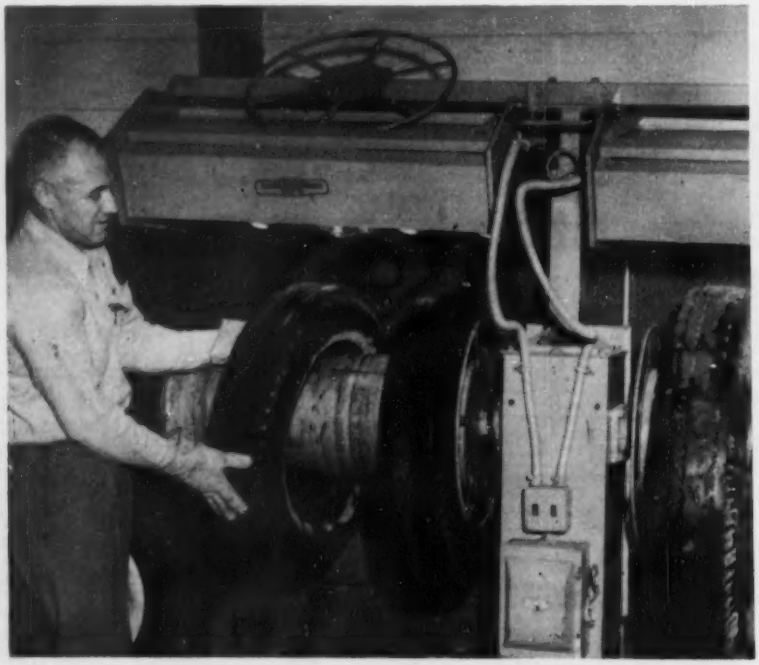


Nuclear Engineering is the title of a new book, due this month, by Richard Stephenson, Consulting Chemical Engineer. This is the first book to bring together the many unique engineering problems encountered in the nuclear energy field.

Whatever your immediate research, design or engineering problems, however unusual they may be, an early consultation with Kaiser Engineers is an important step toward their quick, profitable solution. Call or write Kaiser Engineers Division of Henry J. Kaiser Company, Kaiser Building, Oakland 12, California.

a better appearance.

The oven has inside dimensions of 4 by 4 by 3 ft. It is made of 16 gage steel with welded angle iron structure. It has a total of 30—250-w, 220-v infrared lamps—15 lamps on each side, arranged in rows of 5 lamps each. Each row is connected on a separate circuit controlled by a separate tumbler switch. In this way complete flexibility of heating and baking of the various type and size parts is obtained. About 50 manhours was required by the mechanics to make the oven in spare time at the Southern Airways shop.



REMOVING MOISTURE from wet tires under infrared lamp bank permits processing (before retreading) after 30 to 45 min, compared with 1 to 1½ days by air drying

Infrared Cuts Tire Drying Time

Drying wet tires before retreading is being done at Gordy Tire Co, Atlanta, Ga., faster, safer and at less cost by infrared lamps. Production is increased as a result of the steady flow of tires from the drying equipment. It occupies very little floor space, is highly efficient and tires are throughly dried in a period varying from 30 to 45 min.

Previously the wet tires were placed in a heated room and 1 to 1½ days were required for thorough drying. Some of the tire shops use an open hot tire mold for this purpose. But this method puts a mold out of production.

All wet tires must be thoroughly dried before retreading; otherwise the steam which is developed, when the tires are placed in the hot mold, may cause the ply to separate. Serviceability of the tires is thus greatly damaged or destroyed.

The machine shade has a total of 24 - 250-w lamps, 12 on each side (four lamps in each of three rows). Shade is 13¾ in. high, 2 ft 7½ in. wide and 6 ft 7¼ in. long.

Machine has two reels, one on each side and individually operated. Reels are 12 in. in diameter and 2 ft 6 in. long.

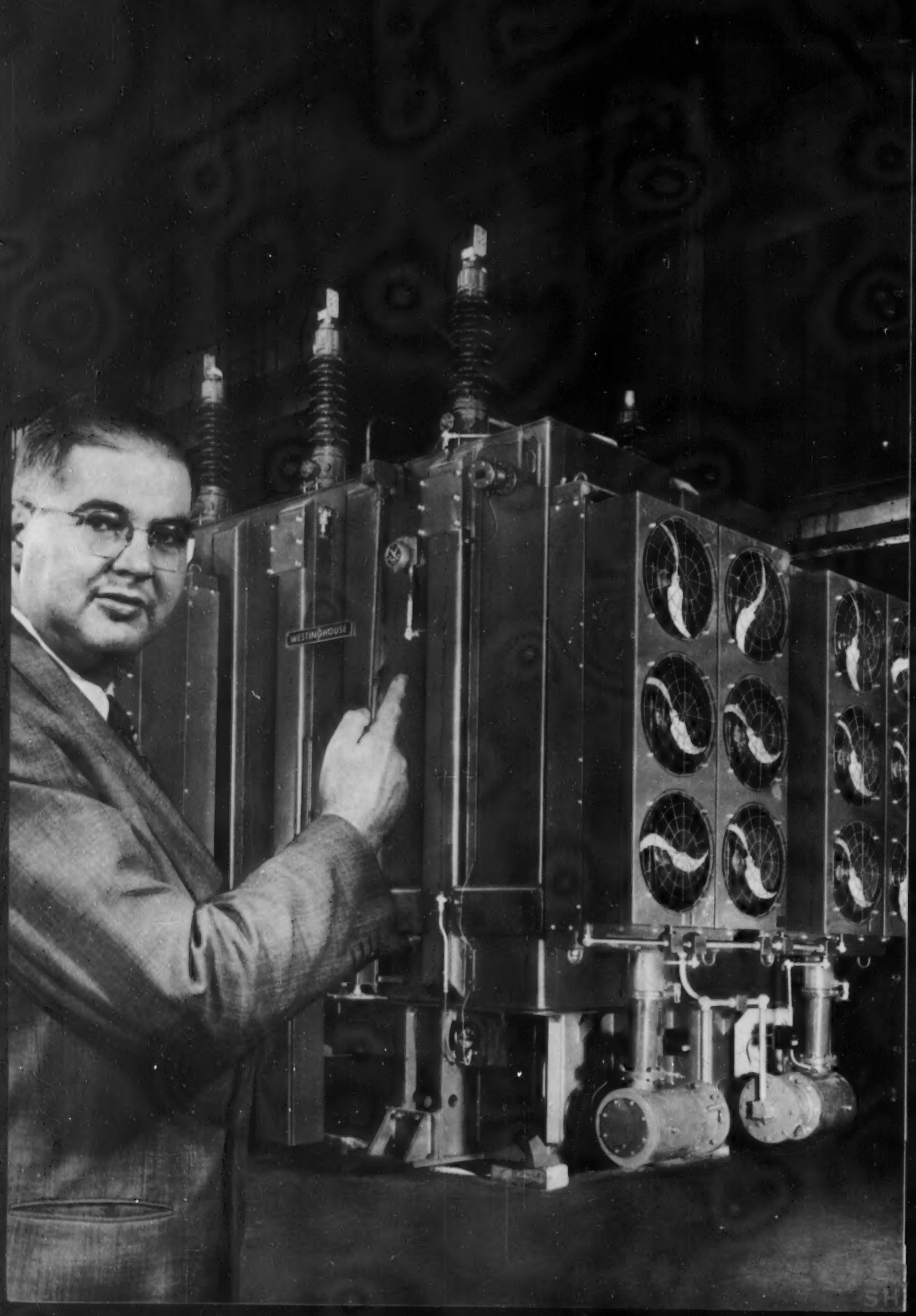
Reels are driven by ¼ hp motor and rotate at 6 rpm. A total of eight to 10 passenger car or six truck tires can be dried on the machine at one time. Motor and lamps draw a total of 56 amp.

Industrial Briefs follow on page 167
(*Continued on page* 167)

M. L. Gardner, Westinghouse Engineering and Service Manager, Northeastern Region, introduces a panel of Westinghouse engineers who will discuss ways of . . .

Reducing your system operating headaches

To many utility people, Matt Gardner is "Mr. Westinghouse." In 30 years of distinguished service, he has been associated with practically every phase of electric utility engineering—research, development, application, service. On the following eleven pages, Matt and other top Westinghouse engineers will show you how quality-engineered equipment can solve or simplify system operating problems.


WESTINGHOUSE

"John Rissinger, Manager of Power Transformer Sales, points out how . . ."

TRO and SP relays minimize transformer operating problems

The TRO relay which for years has enabled you to load your transformers to the limit of their thermal capability is now equipped with a dial calibrated in percent thermal load. This gives your operator direct visual evidence of the thermal condition of your unit, based, as in the past, on a combination of transformer load, oil temperature, ambient temperature and prior load conditions. Three contacts are retained and may be used to control auxiliary cooling, light warning lamps or trip a breaker.

The SP relay provides the operator with the long-sought answer to the problem of detecting transformer faults before extensive damage results.

Mounted on the side of the tank opposite the gas space, the new relay is designed for alarm-trip circuit closing on the occurrence of an internal fault producing an abnormal pressure rise. It will detect rates of change even smaller than two ounces per square inch per second. For steep-front increases of 40 pounds per square inch per second, it will operate in ½ cycle.

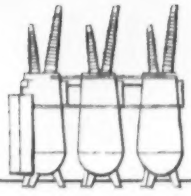
Disturbances such as inrush current, short circuits, impulse voltages or mechanical shock will not actuate the relay.

With these and many other equally important design features, you can be sure that Westinghouse power transformers will reduce your operating and maintenance headaches.

TRO thermal relay

Sudden pressure relay

The next page shows how Westinghouse breaker mechanisms solve a problem for you, too.



YOU CAN BE **SURE**...IF IT'S

Westinghouse

"Here's Jack Stirling, Power Circuit Breaker Sales Manager, with the answer to the problem of operating high-voltage circuit breakers."

Pneumatic mechanisms offer high-speed, trip-free operation . . .

Today's high-voltage, high-capacity breakers require not only a powerful closing mechanism, but one that is mechanically trip-free for fast action under any conditions—3-cycle opening, 15 to 20-cycle reclosing. And yet one that is simple, accessible and easy to maintain.

The Westinghouse Type AA mechanisms are daily meeting these basic needs—powerfully closing the largest breakers, even on faulted lines—opening mechanically trip-free, without delays—reclosing in the shortest time.

Mechanically trip-free operation insures unretarded, high-speed opening of the breaker even when closed in on a fault. A pneumatic trip selector, however, provides for ultra-high-speed reclosing. Tripping "non-trip-free" only when no compressed air is in the cylinder, the contact travel is smoothly reversed before the end of the opening stroke by the early admission of compressed air into the cylinder. This, first, cushions the opening and, second, recloses without the contacts or breaker parts moving at excessive speeds. There is no shock or hammering of oppositely moving parts, since the piston and contacts are tied together and move in the same direction during the complete operation.

Westinghouse pneumatic mechanisms utilize low air pressure with time-proven pressure accessories.

Corrosion-resisting metals are used throughout, and exclusive roller bearing latches—*not* custom fitted—require no field adjustment for life.

These outstanding mechanisms are available on the complete range of Westinghouse oil circuit breakers from 14.4 kv, 500,000 kva through 330 kv, 25,000,000 kva.

YOU CAN BE **SURE**...IF IT'S

"Al Cleveland of Voltage Regulator Sales points out two good reasons why Westinghouse induction voltage regulators help reduce your operating headaches."

No "contact bounce" frees this regulator from contact wear

When you compare the operating and maintenance characteristics of voltage regulators—almost everyone agrees on the superiority of an induction regulator in those applications requiring high frequency of operation.

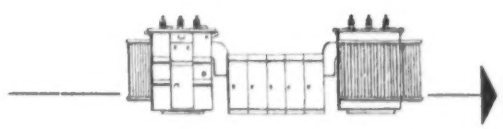
The new Westinghouse Type SU improves on the average induction regulator by an exclusive "no bounce" contact design common to its motor-operating and voltage-regulating relays. No bouncing means no arcing—no contact wear.

The design, through a spring hinge, eliminates all bearings and pivot points. In a recent laboratory test, over 100 million operations (more operations than 200 years of typical field service) failed to produce hinge fatigue or contact wear. The original calibration remained unchanged.

In addition, the all-electric control panel on the SU regulator simplifies operation. All adjustments are made by simply turning the knobs on the convenient control panel. No tools are necessary.

On an application requiring frequent voltage corrections, you can't beat a Westinghouse Type SU induction regulator for fast, smooth operation—at greatly reduced maintenance.

For substantial evidence that Westinghouse unit substations are unmatched in the industry, turn the page.



Westinghouse

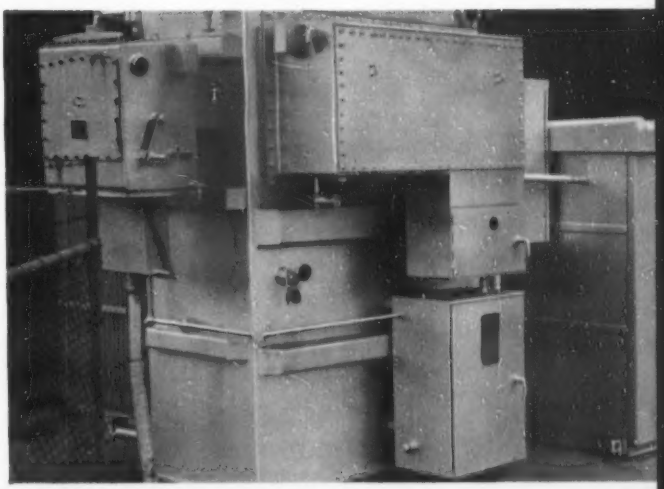
"Here's Wally Payne with some specific reasons why his unit substations can reduce operating problems."*

Westinghouse unit substations simplify station conversion . . . operation . . . maintenance

Today, many utilities reduce the magnitude of their system operating problems by dividing areas into smaller blocks of power. They report that unit substations make the conversion easy, as well as simplifying station maintenance. Too, compactness and flexibility reduce both cost and effort of keeping pace with load shifts.

But even more, advantages of Westinghouse unit substations go several steps further to relieve operating headaches. For example:

The transformer-mounted, underload tap changer, with its direct connected mechanical drive, eliminates springs, latches and shock absorbing devices, thus achieving a positive, reliable, quiet drive having a small number of parts with resulting low maintenance.



Underload tap changer

Drawout "De-ion®" air breakers operate on an exclusive arc-quenching principle that lengthens contact life, reduces maintenance. The drawout feature makes quick inspection easy, completely safe.

All-weather undercoating of all compartments—not just the transformer—provides extra weather protection as a standard feature.

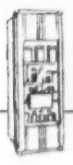
All compartments undercoated

Unit responsibility. Westinghouse unit substations have *all* components engineered and coordinated by one manufacturer with complete control of design, manufacturing and assembly. Westinghouse components are built . . . not adapted . . . for their ultimate job.

Westinghouse has long been a designer and manufacturer of a complete line of power distribution apparatus for any system requirement. The men and organization to make this experience available to you are as near as your telephone. They're ready and anxious to serve.

**Manager of Unit Equipment Sales.*

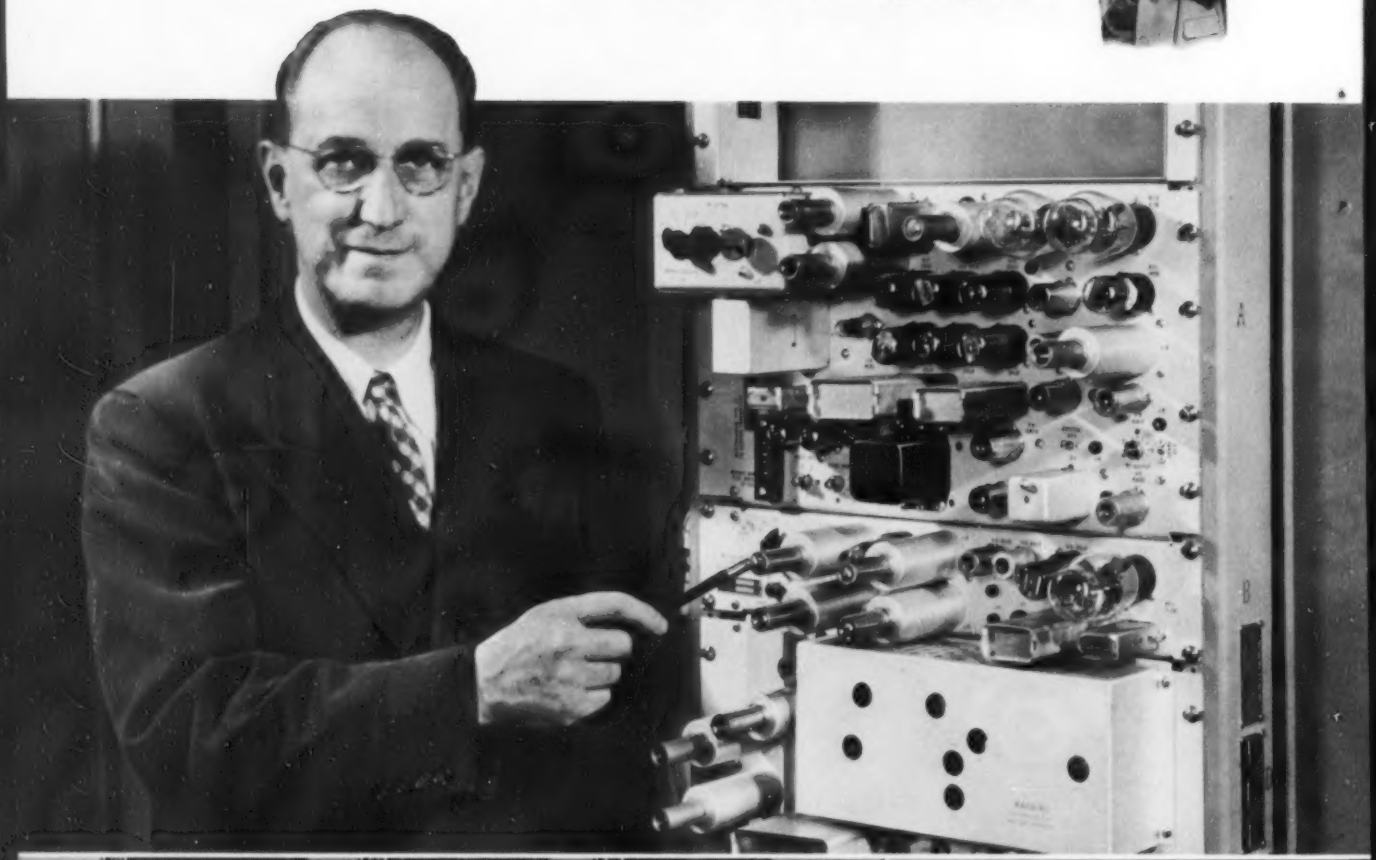
The next pages show how a versatile relay avoids unnecessary trip-out.

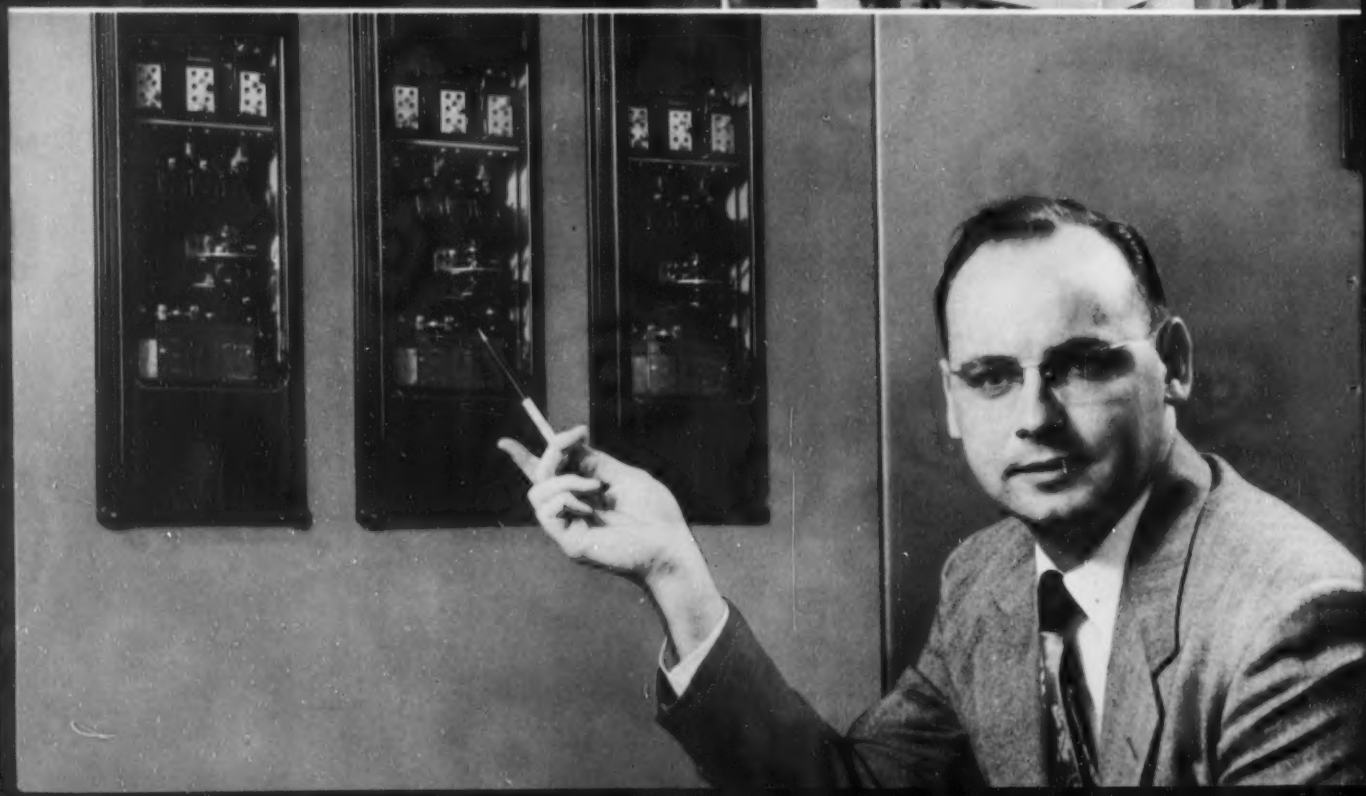


YOU CAN BE SURE... IF IT'S

Westinghouse

"Power line carrier equipment and relays work hand in hand to give you system stability," say Jim Booth, Carrier Engineer and Bill Rich, Relay Engineer."





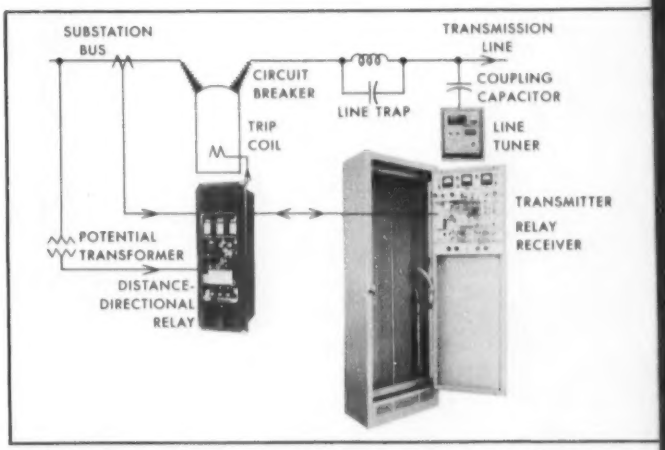
Smooth coordination of Westinghouse relays and carrier minimizes line disturbances

For full protection of key high-voltage transmission lines, it is good business to specify Westinghouse Type HZM relays and Type FD power line carrier as the relaying channel. Working together, this equipment permits simultaneous tripping and reclosing—over 100% of each protected line section —without time delay.

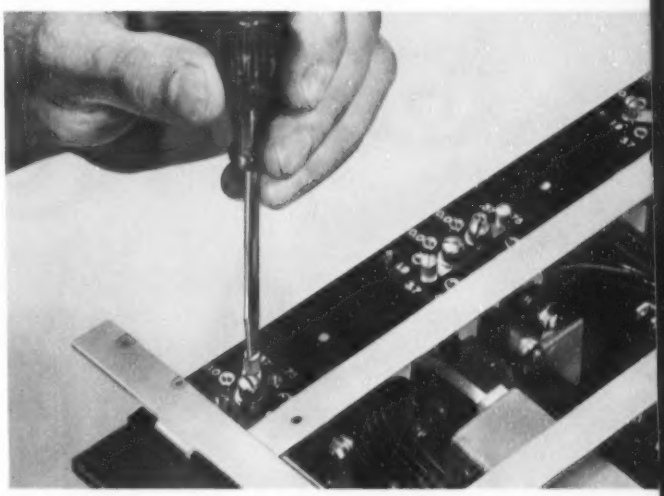
HZM relays alone provide instantaneous protection for 80 to 90% of the line section. Type FD carrier extends this protection to critical end zones for complete coverage. HZM relays and FD carrier are carefully coordinated to operate together smoothly, efficiently.

Type FD carrier is new, and has many outstanding features. Superselective receivers, for instance, provide more usable channels within the 40 to 200-kilocycle frequency range. Built-in automatic current regulators—used in carrier for the first time—assure maximum tube life and reliability. FD carrier operates through circuits having as much as 40 decibels attenuation, affording a large safety factor for changing line conditions. A new, wide-range sleet detector checks the entire carrier channel including vacuum tubes and other carrier components. FD carrier is also available in assemblies for telemetering, supervisory control, voice communications and other functions.

The HZM relay is extremely fast acting—operating in less than three cycles. Fundamentally, impedance relays do not operate on loads or synchronizing surges, even though they may be greater than fault currents that *do* trip the relay. In the HZM relay, this feature is extended even further by offsetting the operating characteristics of any or all of the three impedance elements, as required. Westinghouse also makes the HZ-4 relay in which only the third element can be offset.

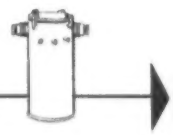


A basic distance-directional relaying system, using indoor-mounted Westinghouse Type FD carrier and Type HZM relays.



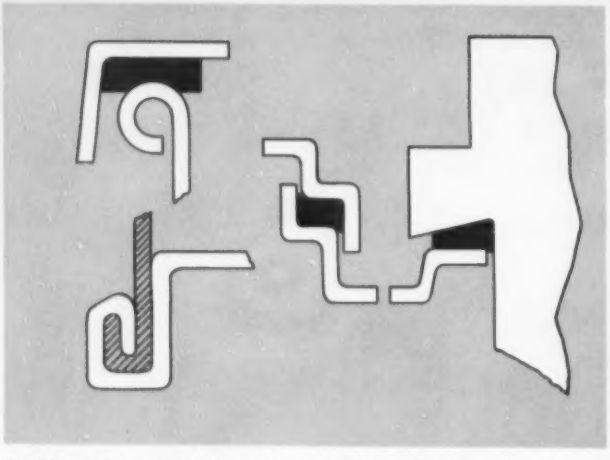
The network for offsetting the impedance circle of the HZM relay is now built in—no auxiliary box is required.

You'll see how special construction solves transformer operating problems on the next page.

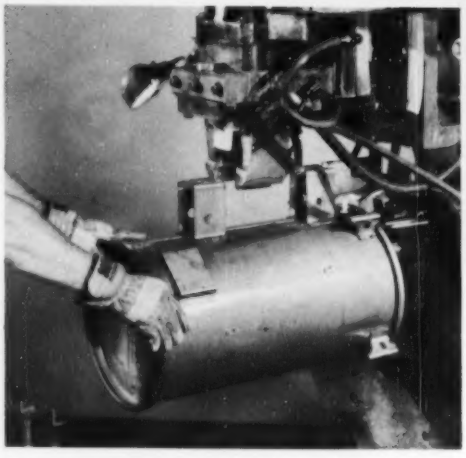


YOU CAN BE **SURE**...IF IT'S

Westinghouse



Double-rolled tank bottom assures positive oil-tight seal and protection against damage in handling. Main and handhole covers are sealed by cork-neoprene gaskets, firmly positioned to assure tightest possible seal.



Hanger lugs, nameplate bracket, lifting lugs and other accessories are projection welded to the tank wall. The security of all welded joints is tested by air pressure at 20 pounds per square inch.

"W. L. McKeithan, Section Manager, Distribution Transformer Engineering, discusses a transformer feature that plays an important part in eliminating operating headaches."

This triple-sealed distribution transformer design eliminates possible trouble

All Westinghouse distribution transformer tanks are made of highest quality steel with positive seals—at the tank bottom—at the cover—and at all accessory locations.

Exclusive rolled tank bottoms have oil-tight, double-rolled rims. Since the design prohibits the transformer weight from ever stressing the seal, the transformer can be stored, moved, loaded or installed without the extra care required by common designs.

Covers, handhole and bushings are sealed with cork-neoprene gaskets. Cork-neoprene is impervious to oil, moisture and corrosive elements—will not take a permanent set—is not subject to aging, stress cracking and has no seam. It assures a positive seal for the life of the transformer.

Hanger lugs, nameplate bracket, lifting lugs and other accessories are projection welded to the tank wall. The security of all joints is tested by air pressure at 20 pounds per square inch.

Triple-sealed tank construction is just one of the several features of Westinghouse distribution transformers that add up to less operating headaches at a vital point in your distribution system. It will pay you to investigate further.

How to get optimum performance from all of this equipment is discussed on the next page.

YOU CAN BE **SURE**...IF IT'S

Westinghouse

Westinghouse field engineers lick operating problems before they start. M. L. Gardner, Engineering and Service Manager, Northeastern Region, cites a typical case:

How Westinghouse helped the Astoria Station get off to a fast, smooth start

"It takes time and teamwork to get a new generating station like Consolidated Edison's Astoria on the line and running smoothly.

"Under my supervision, Joe Greenbaum—the Westinghouse field engineer assigned to Con Ed—lived with this job right from ground breaking. Westinghouse supplied four 100,000-kva generator transformers, station auxiliary switchgear, main control board and powerhouse auxiliary motors. We were there to help supervise erection, installation, connection and check-out of Westinghouse apparatus. We worked closely with Con Ed engineers to tie all equipment together into a smoothly functioning operation.

"We were all pleased when Astoria went on the line and, what's more, we'll help keep it that way by frequent inspection and servicing of all Westinghouse equipment."

* * *

M. L. Gardner's story proves this point: the best performance results only when quality apparatus is matched with quality field engineering service.

Over 1200 Westinghouse district engineering and service men make sure that *you get the performance you buy* in every piece of Westinghouse apparatus. It's a service that frequently makes the difference between Westinghouse and other equipment, *all the difference in the world!*

For further details, go over this check list with your local Westinghouse representative . . . or we'll gladly mail specific data on written request to Westinghouse Electric Corporation, 3 Gateway Center, P. O. Box 868, Pittsburgh 30, Pennsylvania.

Distribution Transformers	DB 46-1005	Carrier-Microwave	B-5873
Power Transformers	B-4142A	Relays	DB 41-412
Power Breakers	DB 33-125 and B-5904	Unit Substations	B-4061, B-5306, DB 47-410

YOU CAN BE **SURE**...IF IT'S

Westinghouse

CP-1014

INDUSTRIAL BRIEFS

Space heating of islolated switchgear room at Canton Drop Forge & Mfg. Co, Canton, Ohio, with 3-kw heater has eliminated condensation of moisture on equipment and removed danger to high voltage cables and switchgear. Changes in relay calibration due to wide temperature variations in unheated room have also been eleminated. Thermostatic control maintains room temperature of 45 F. G. W. Craiglow, Industrial Power Engineer, Ohio Power Co, Canton.

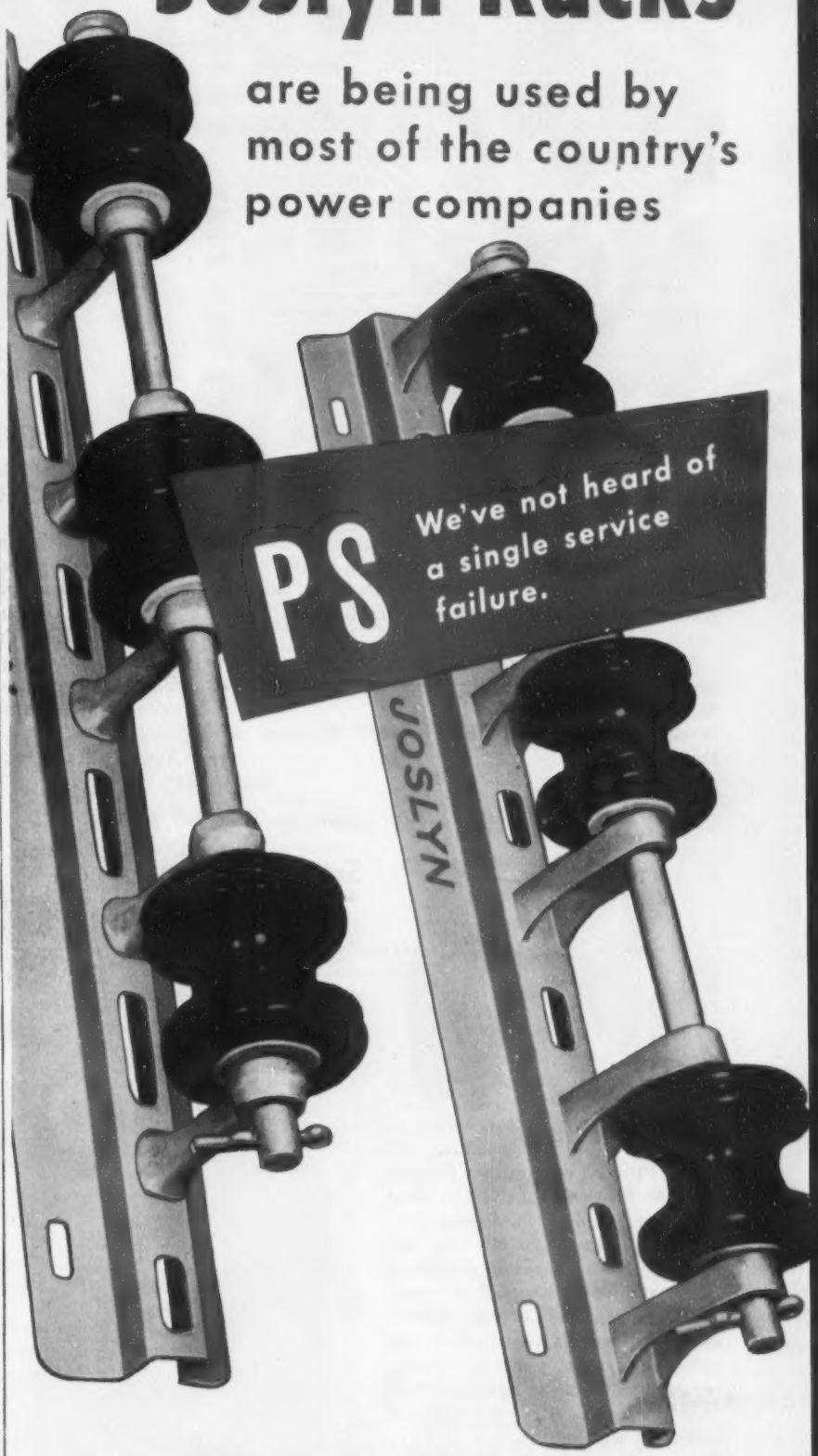
Drying tires with infrared lamp banks at Gordy Tire Co, Atlanta, Ga., permits them to be processed (before recapping) after 1½ hr. Formerly 1 to 1½ days storage in air drying room was required. Each of the two banks has 12 - 250-w infrared lamps. Each bank accommodates five passenger car size tires.

Localized lighting at Winchester Electronics, Inc, New Milford, Conn., makes component parts of connectors stand out sharply in assembly operations and supplements 45 ft-c of general illumination. Eye fatigue is reduced and production speeded up. Multiple connectors of copper are installed on plastic blocks against a green felt background. Each bench position has a flexible arm fluorescent fixture with two 15-w lamps concentrating 300 to 350 ft-c on the work. By using more light "around the clock," 110 day-shift and 60 night-shift assemblers benefit.

Heating dies for cylindrical tank heads at Scaife Co, Oakmont, Pa., using 12 - 3-kw semi-circular sheath heaters has produced accurate heads and eliminated spoilage and possible die cracking. Formerly, inaccurate pieces were produced when starting up until dies were heated by friction to proper temperature. The 3-kw heaters, mounted in a portable frame, are placed on the dies and energized at predetermined time before press is started up. When operations are ready to start, heating unit is removed from press and dies are at proper operating temperature. J. B. White, Jr., Supervisor, Industrial Sales, Duquesne Light Co, Pittsburgh, Pa.

Joslyn Racks

are being used by most of the country's power companies



JOSLYN

Executive Offices
20 N. Wacker Dr.
Chicago 6, Illinois

NEW EQUIPMENT

Earth Boring Machine

The Sterling Model G-4 hydraulic control earth boring machine uses 10 to 20 in. augers and digs to 9½ ft deep. A heavy duty transmission is coupled to a 58-hp, industrial-type, 4-cylinder gasoline engine and has 3 speeds forward and 1 reverse.

Weight of the machine is 3,150 lb. The hydraulic rams and drive assembly in the machine are the same as on Model "A."

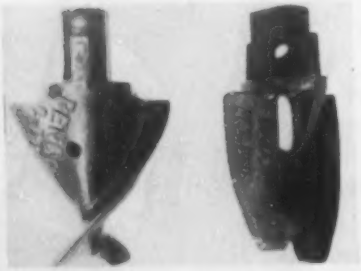
Wyoming Valley Equipment Co, 1089 Wyoming Ave, Forty Fort, Pa.

All-Purpose Digger

A medium size, all-purpose digger is made either as a rugged skid-mounted unit with self-contained power plant or as a compact power take-off unit for jeep or power take-off truck mounting. The digger provides angular adjustment of the drill head in two directions and permits operation at any angle through a full 360-deg range.

Built-in hoist handles loads up to 750 lb. By using sectional, continuous flight augers, depths up to 75 ft can be reached.

Acker Drill Co, Inc, Scranton 3, Pa.



Auger Pilot Bits

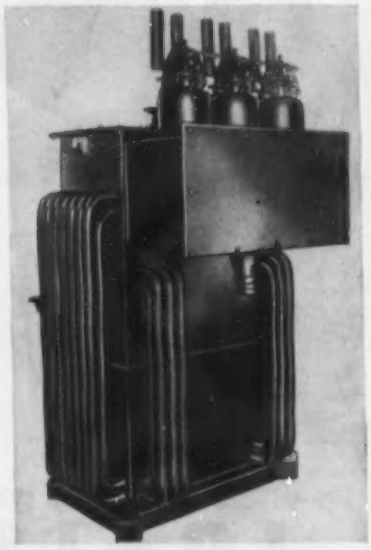
The PENGO combination Fishtail-Hardpan Pilot and the PENGO Cone Pilot supersede both the former Fishtail and Hardpan pilot bits. Bits are interchangeable between company's augers and boring heads of all sizes.

Company claims narrow fishtails open small hole in hard surfaces and moldboards screw in, making effective penetration. Strain is chiefly in compression, so bits are heat-treated for maximum wearing life.

Peterson Engineering Co, Santa Clara, Calif.

Substation Transformers

A line of unit substation transformers is announced, rated in standard or special sizes up to 500 kva, 3-phase, and up to 15,000 v. Transformers are liquid-filled type.



Besides standard accessories, other features may be supplied, such as integral junction boxes enclosing terminals, primary entrance pothead for lead-covered cable in conduit, and gang-operated oil fuse cutouts which afford fuse protection and switching from the primary supply line. Supplied for indoor or outdoor installation.

Eisler Engineering Co, Inc, 750 S. 13th St, Newark 3, N. J.

Closing Device

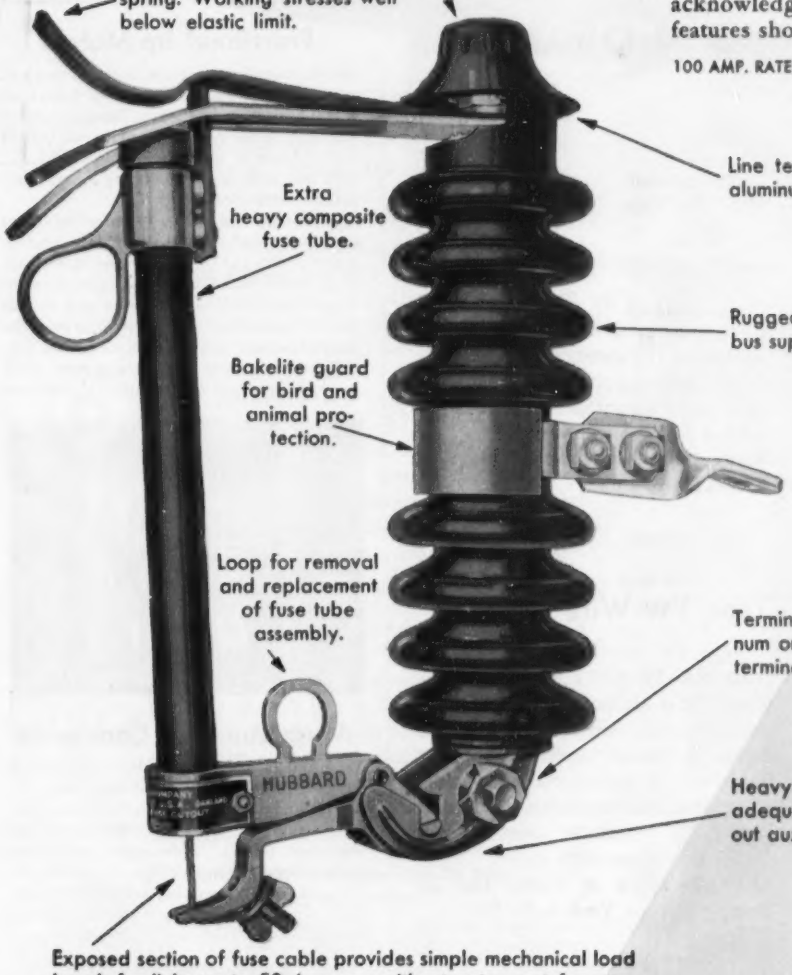
Portable emergency closing device provides safe, full-speed closing of a circuit breaker when no normal source of closing power is available. Pneu-Draulic closing device for use on 13.8- or 4.16-kv classes of Ruptair circuit

A New Hubbard 7.5 KV Load Break Cutout

RUGGED • SIMPLE DEPENDABLE

A significant addition to the Hubbard line of electrical apparatus is made with the new No. 2531 load break cutout. Distribution loads may be switched with this simple design without any increase in cost in cutout investment. Simple re-fusing requires no tools. The early enthusiastic acceptance of No. 2531 is evidence that it supplies an acknowledged need. Note the distinctive features shown in the illustration.

100 AMP. RATED—2000 AMP. INTERRUPTING CAPACITY.


Terminal cap for effective bird and animal protection.
Extra long contact and action spring. Working stresses well below elastic limit.
Line terminal plated for use with either aluminum or copper conductor.
Extra heavy composite fuse tube.
Rugged one piece porcelain column with bus support type assembly.
Bakelite guard for bird and animal protection.
Loop for removal and replacement of fuse tube assembly.
Terminals plated for use with either aluminum or copper conductor. Alternate load terminals for right or left hand connection.
HUBBARD
Heavy bronze safety lock hinge provides adequate current carrying capacity without auxiliary contacts.
Exposed section of fuse cable provides simple mechanical load break for links up to 50 Amperes without extra cost for cumbersome parts.
Straight mechanical withdrawal fuse cable of particular importance when currents of small magnitude are extinguished.

HUBBARD AND COMPANY

ESTABLISHED 1843

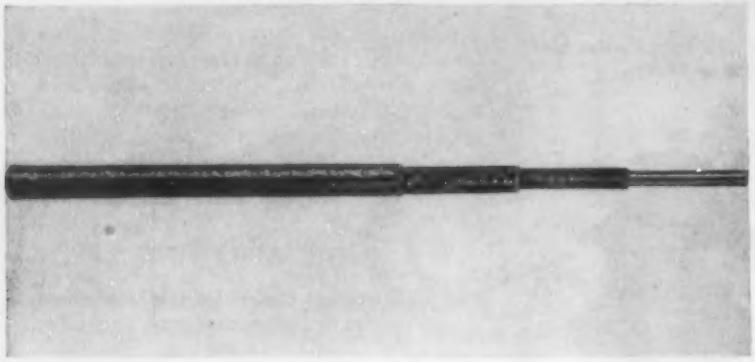
PITTSBURGH • CHICAGO • OAKLAND, CALIFORNIA

"Hang the Load on Hubbard Hardware!"

breakers, or other standard air magnetic circuit breakers in metal-clad switchgear. Device, weighing 40 lb and measuring 8 x 4 x 10 in., consists of:

1. Manually - operated hydraulic pump with built-in reservoir and bypass valve.
2. Accumulator tank utilizing bag under pressure for energy storage.
3. Closing valve and hydraulic interlock to prevent operation on insufficient energy storage.
4. And an operating cylinder connected to the breaker solenoid plunger or its linkage by detachable bracket.

Allis-Chalmers Manufacturing Co, 932 S. 70th St, Milwaukee, Wis.



Weatherproof Wire

Weatherproof wire with outer braid of glass yarn is available in sizes 14 through 4AWG, in 500-ft coils. Glass outer braid is resistant to moisture, heat, chemical action, and abrasion. Tests show very little moisture pick up. Glass yarns have high tensile strength which is retained indefinitely. Resistance to chemicals makes glass yarn a good support for asphalt coatings, and is advantageous for locations subject to chemical vapors.

Rome Cable Corporation, Ridge St, Rome, N. Y.

Underground Cable

Nepconol Type UF cable is suited for farms and rural areas. Cable is available as single conductor (sizes 14 to 4 AWG), and as two conductor (with or without ground wire) and in three conductor (14 to 10 AWG). Cable is for direct burial underground and is resistant to moisture, acids, and oils.

Conductor insulation and outer jacket is thermoplastic. Fiber glass members separate conductor insulation from jacket and add strength. Cable is also usable as non-metallic sheathed cable, corrosive resistant, Type NMC. Multiple-conductor cables may be used for interior wiring, exposed or concealed, in dry, wet, or corrosive locations and for installation inside masonry or walls.

National Electric Products Corp, Gateway Center, Pittsburgh, Pa.

Type TW Wire

Type TW wire is available in sizes from No. 14 AWG to 2,000 Mcm. Type TW is claimed to be resistant to moisture, oils, most chemicals, and flame. A special "slipper compound" finish aids in pulling the wire under all weather and installation conditions. This finish reportedly does not dry out or deteriorate with age.

Anaconda Wire & Cable Co, 25 Broadway, New York 4, N. Y.

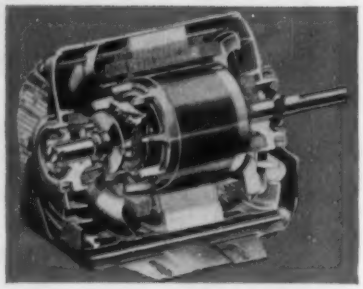
Television Camera

Utiliscope Model 300-BV camera for wired television is a small unit having high resolution and using lower lighting levels than previous models. The camera combines simplicity of operation with operational

(*Continued on page* 174)

(ADVERTISEMENT)

Electrical Applications of Aluminum

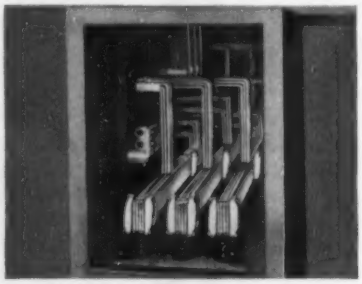


Fractional-hp Motors

Motor manufacturers are finding more and more ways for aluminum to help make fractional-hp motors smaller . . . lighter . . . more versatile. These new motors give full NEMA performance at up to 50% less weight . . . 40% less bulk, rating for rating . . . at lower manufacturing cost.

Aluminum makes cast rotor windings practically indestructible. Fan blades cast integrally with the rotor make for cooler running. Stator windings of aluminum wire cut weight appreciably. Aluminum end shields give better conductivity of heat away from the motor bearings to provide longer bearing life.

Reynolds furnishes high quality rotor metal in aluminum pigs of various compositions.



Aluminum Bus Conductor

More and more aluminum bus conductor is being used in prefabricated duct units for shop distribution and as a part of other electrical equipment such as control panels and electronic circuits. Aluminum's increasing use in electrical applications is due largely to its lower cost, high electrical conductivity, light weight with high strength, ease of fabrication and more certain availability.

Engineering Service

Reynolds Engineering Service is available to help you on any type of electrical application for aluminum. For example, Reynolds Engineers will conduct meetings with your men and provide them with the latest information on all phases of aluminum design and fabrication. This service is available without cost or obligation. For full details contact your nearest Reynolds Branch Office or write Reynolds Metals Company at the address on the facing page.

Now You can Specify REYNOLDS

NEOPRENE COVERED ALUMINUM CONDUCTOR

for secondary lines
and service drops

Now! You can get highest quality covered aluminum conductor from Reynolds—single conductor and self-supporting duplex, triplex or quadruplex cables. Also you can rely on Reynolds Engineers to give you impartial information on the right type of covered conductor for your particular secondary distribution line and service drop needs.

Why aluminum conductor? Because the lighter weight of aluminum speeds installation, cuts labor costs and permits longer spans. And because the initial cost of aluminum is lower. These factors add up to important savings to you!

Why *Reynolds* covered aluminum conductor? Because the tough Neoprene covering is long-lasting and weather-resistant. Because Reynolds has modern facilities for producing conductor and cable with quality control from mine to finished product. Because these modern facilities are backed by experienced production, engineering and sales personnel. And because this help—as proved in countless Reynolds ACSR installations—is readily available to you both in the office and in the field!

For full details on Reynolds Neoprene Covered Aluminum Conductor call your nearest Reynolds Branch Office or write Reynolds Metals Company, 2584 South Third Street, Louisville 1, Kentucky.

"REYNOLDS ALUMINUM IN THE ELECTRICAL INDUSTRY"

Send for your copy of this new brochure—includes photos and helpful information on Reynolds Covered Conductor, ACSR, Bus Conductor, Engineering Service, etc. Write to the address above.

See "Mister Peepers" Sundays on NBC-TV. Consult local listings for time and station.

REYNOLDS ALUMINUM

MODERN DESIGN HAS ALUMINUM IN MIND

The instrument that put electronics to work

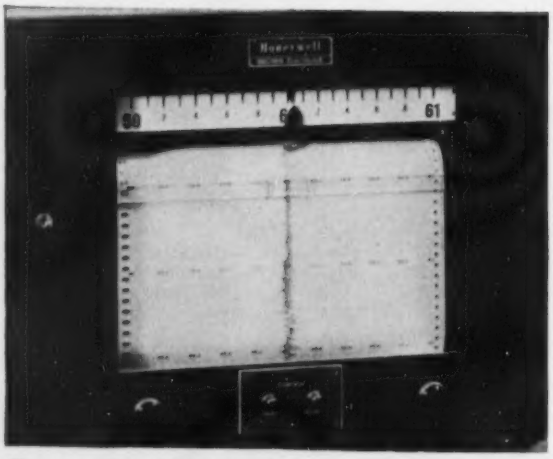
Before electronics came into the picture, industrial instrumentation was caught in a squeeze. On one hand, it was besieged with demands by production men and engineers for higher sensitivity, faster speeds, and greater reliability. And on the other hand, it was hampered by the limitations of mechanical devices. For the instruments of fourteen years ago were merely mechanical imitations of a man watching a galvanometer needle and twiddling dials. They were too delicate . . . too sensitive to vibration . . . too easily led astray by wear or maladjustment. They just couldn't deliver the performance that new production methods required.

In 1940, however, came a major milestone in the progress of instrumentation—development of the *ElectroniK* potentiometer. This was not only a new kind of instrument. It was a new concept of measurement. For the first time, it applied the science of electronics in a practical way to the design of a measuring device for industry. It replaced complicated, fragile mechanical gadgets with a simple but sensitive electronic circuit and servo system . . . the "Continuous Balance" principle of measurement.

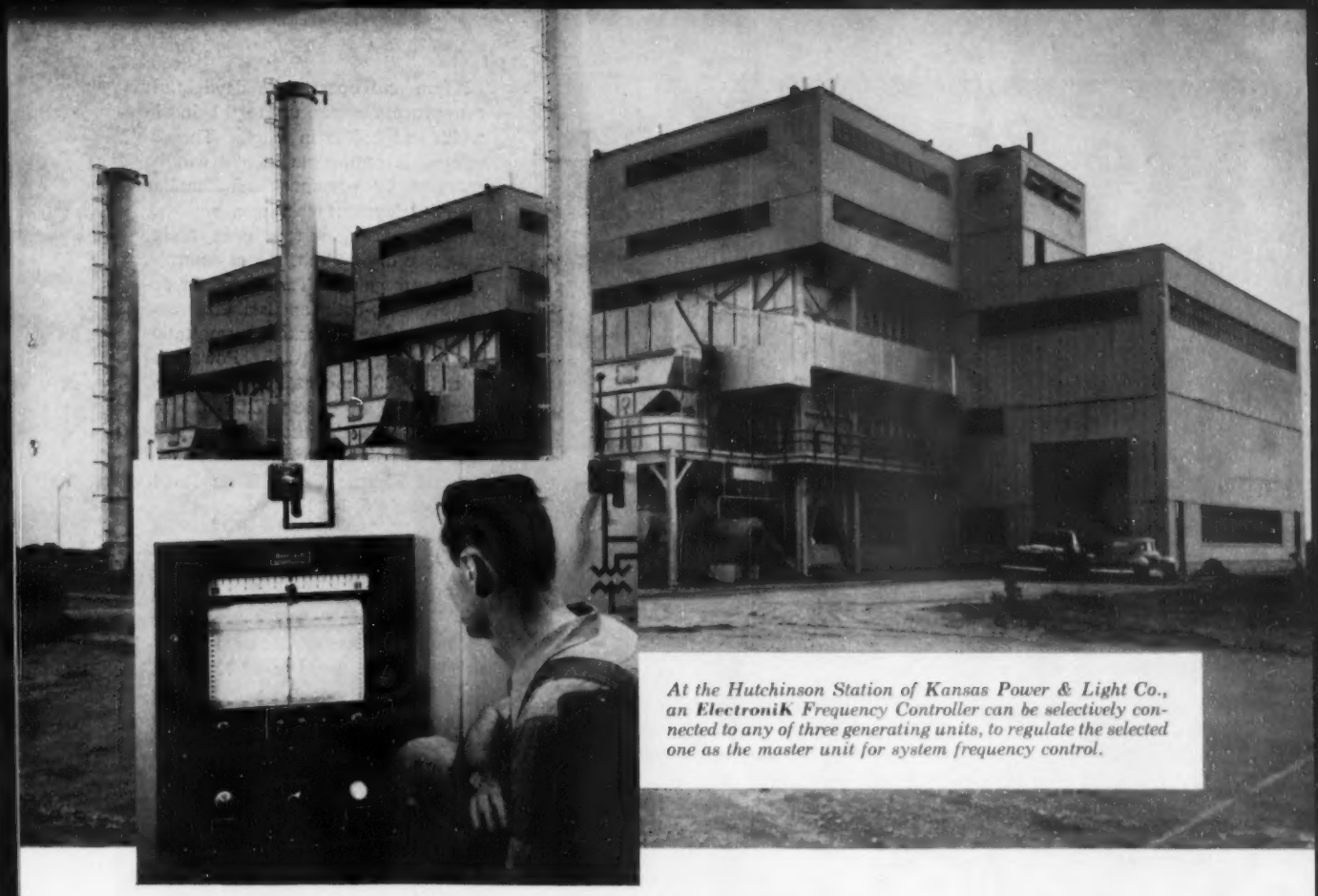
You could tell it was something new when you opened up the *ElectroniK* instrument's case. There was no sign of whirring gears, levers and cams. You could tell it was giving a new kind of performance in measurement, too, by the way the pointer would move swiftly and surely in one smooth sweep whenever the measured variable changed.

The *ElectroniK* instrument gained quick acceptance by production men, engineers, research technicians and maintenance men. They liked the way it provided laboratory accuracy and sensitivity, week after week, under the toughest industrial service conditions. They found that its speed and precision made possible improvements in product quality and process operation that had been unattainable before. And they have proved their confidence by ordering and reordering *ElectroniK* instruments by the thousands . . . not solely because it was *first* of its kind, but because it has continued to be the *best* in performance.

ElectroniK frequency recorder sets new standards



The range from 59 to 61 cycles per second is spread across 10½ inches of calibrated chart.



At the Hutchinson Station of Kansas Power & Light Co., an ElectroniK Frequency Controller can be selectively connected to any of three generating units, to regulate the selected one as the master unit for system frequency control.

for measurement and control

RECORDING and controlling of system frequency reaches a new level of performance when the *ElectroniK* Frequency Recorder goes to work for you. By applying the electronic "*Continuous Balance*" principle, this instrument makes available greater precision, speed and sensitivity than ever before possible.

It's more accurate . . . embodies a pulse frequency-to-millivolt converter in a null-balance precision d-c bridge circuit with an over-all accuracy of ± 0.01 cps.

It's fast . . . high-speed electronic balancing follows every change in frequency. Full scale pen speeds of 12 or 24 seconds are available.

It's sensitive . . . responds to frequency variations as small as 0.005 cps . . . spreads the range from 59 to 61 cycles across 10½ inches of calibrated chart.

As a recorder, the instrument gives operators better data on which to base generation changes . . . is also supplied to chart both frequency and time deviation. As a controller, it incorporates auxiliaries engineered by Honeywell to regulate turbine governors for flat frequency or tieline bias under fluctuating load conditions.

Your nearby Honeywell sales engineer will be glad to discuss applications in your own power plant. Call him today . . . he's as near as your phone.

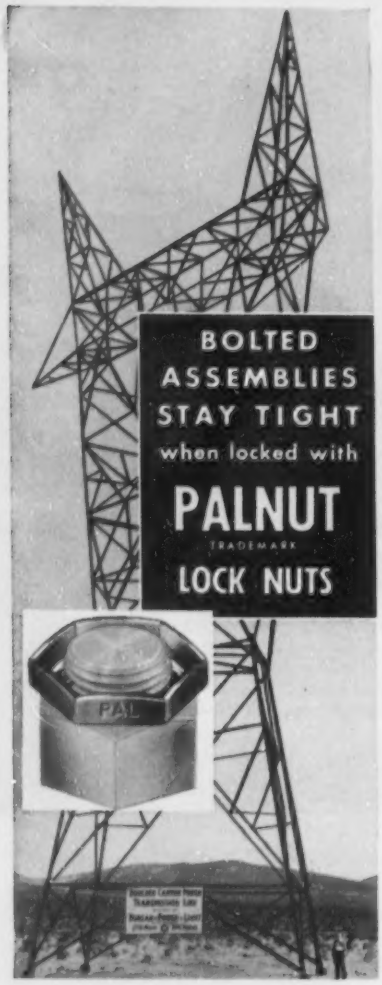
MINNEAPOLIS-HONEYWELL REGULATOR CO., *Industrial Division*, Wayne and Windrim Avenues, Philadelphia 44, Pa.

● **REFERENCE DATA: Write for Catalog 90-1, "Supervisory Instruments for Power Generation".**

MINNEAPOLIS **Honeywell**

BROWN INSTRUMENTS

First in Controls



Specify PALNUTS on new lines . . . add PALNUTS to existing lines, to eliminate further re-checking and re-tightening of bolts. PALNUT Lock Nuts are the lowest cost, most dependable method of locking steel tower bolts. Once tightened, their double locking spring action holds tight under severest vibration.

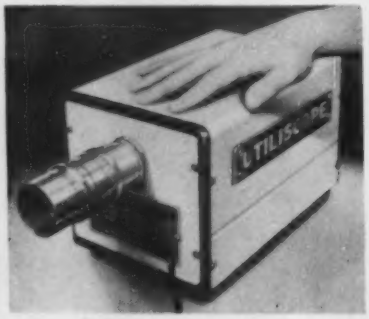
PALNUTS are extremely low in cost, require only 3 bolt threads, apply fast, may be removed and reused. Hot Dip Galvanized and other finishes and materials used by utility industry. Free samples on request.

The PALNUT Co.
51 Cordier St.
Irvington 11,
New Jersey

PALNUT
TRADE MARK
LOCK NUTS
for quick, secure fastening at low cost

New Equipment

(Continued from page 170)



stability. One or more viewing screens may be located wherever convenient.

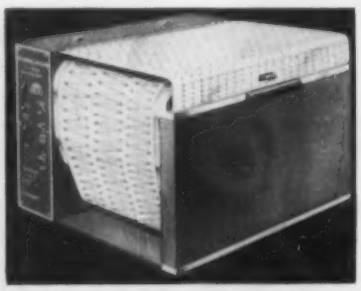
Suggested applications include watching water level and furnace conditions, observing interiors of steel heating furnaces, viewing dangerous and destructive tests, and supervising manufacturing operations from a distance. Model 300-BV is interchangeable with the Model 300-B camera.

Diamond Power Specialty Corp, P. O. Box 415, Lancaster, Ohio.

Induction Motors

A new line of Type G squirrel-cage induction motors in frame sizes up to 326 follows new NEMA standards, yet retains all important features of the "AP" line. All continuous-rated totally-enclosed motors (Type GZ and Type GZZ) will be fan-cooled. Both new open and totally-enclosed (fan-cooled and explosion-proof) models have been exhibited. Production is underway on frame sizes 182 and 184.

Allis-Chalmers Mfg Co, 930 S. 70th St, Milwaukee 1, Wis.



Oscillogram Developer

A rapid oscillogram developer is capable of developing and drying photo-sensitive paper at speeds up to 12 fpm and operates in daylight. It can process paper up to 12 in. in width and 250 ft in length. The developer is semi-portable and can be operated by personnel not familiar with development technique.

Unit consists of four open tanks, a surface drying unit, motor controls, and paper guides. Tanks contain developer, stop-bath, and stabilizer and stand in a water jacket thermostatically controlled at 100F. Power required is 20 amp at 220 v, 60 cps. Dimensions are 15½ x 20 x 23 in. Dry weight of the oscillogram developer is 100 lb.

General Electric Co, 1 River Road, Schenectady 5, N. Y.

Telemetering

The Metaphone signals storage conditions at unattended water reservoir. The reading is available by calling from any convenient telephone.

The measuring system closes a circuit for a length of time proportional to the height of water. The circuit includes a buzzer mounted before a telephone. When someone dials the unattended phone, he can hear the buzzer signal. By timing its duration with a stopwatch, he knows the condition of the storage tank.

Bristol Co, Waterbury 20, Conn.

Barrier Rope

Ipco Poly-rope is designed for making safety barricades around electrical equipment or for roping off work areas. This high-visibility rope is made of two strands of yellow and one of black polyethylene plastic, and exhibits the advantages of this material. The rope runs between 38 and 42 feet to the pound, and its diameter is ⅞ in.

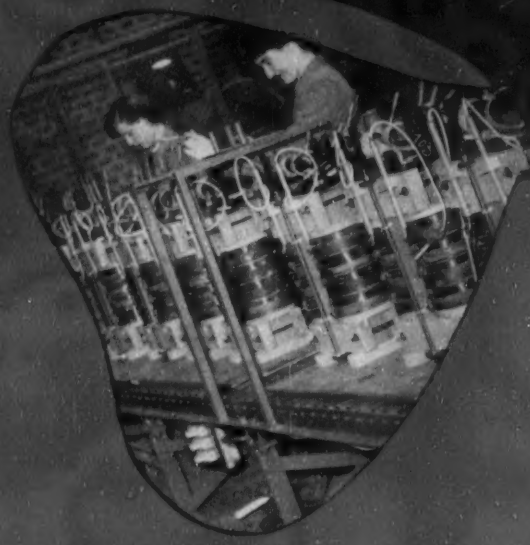
Industrial Products Co, 2808 N. Fourth St, Philadelphia 33, Pa.

Control Panel

Series CP control panel is designed for control of high-voltage power supplies in breakdown test equipment. Panel is available as self-contained cabinet model or as standard rack-mounted unit. Motor-actuated variable autotransformer increases volt-

NATVAR *in* IRELAND!

A group of 5 kva., 10,000-227 volt, single phase pole mounting transformers for Rural Electrification ready for shipment.



In this thoroughly modern production line, transformer core and coil assemblies move along on a conveyor for an assembly operation at each station. Up to the minute insulation is used, too—Natvar 400 Extruded Vinyl Tubing—which is ideal for transformer leads because of its superior resistance to heat, oil, moisture and abrasion.

A.C.E.C. (Ireland) Ltd. has a modern manufacturing plant in Waterford, the city on the southern coast where the world-famous glass is so skillfully made.

In this plant transformers are made for use in Ireland's extensive Rural Electrification Program. Since these transformers must provide continuous service under all operating conditions with a minimum of maintenance, materials that go into them are carefully selected for reliability. Natvar 400 Extruded Vinyl Tubing is used to insulate and protect the leads because of its excellent electrical and mechanical properties, and particularly its resistance to heat, oil and abrasion.

If you need insulation with exceptionally good electrical and physical properties, you can depend on Natvar flexible insulations. They are available either from your wholesaler or direct, and are the same no matter when or where purchased.

Natvar

Natvar Products

- Varnished cambric—cloth and tape
- Varnished canvas and duck
- Varnished silk and special rayon
- Varnished—Silicone coated Fiberglas
- Varnished papers—rope and kraft
- Slot cell combinations, Aboglas®
- Varnished-lacquered tubing and sleeving
- Extruded vinyl tubing and tape
- Styroflex® flexible polystyrene tape
- Extruded identification markers

Ask for Catalog No. 22

NATVAR CORPORATION

FORMERLY THE NATIONAL VARNISHED PRODUCTS CORPORATION

TELEPHONE RAHWAY 7-8800

CABLE ADDRESS NATVAR, RAHWAY, N. J.

221 RANDOLPH AVENUE • WOODBRIDGE, NEW JERSEY

When Life's at Stake Rely on...

KLEIN

Show the familiar Klein trademark to the old-timer on the pole and he'll tell you—"that's the equipment I've been using ever since I was a grunt."

Yes, workmen just naturally feel safer when the equipment is Klein—recognized for quality "Since 1857."

ASK YOUR SUPPLIER

Foreign Distributor: International Standard Electric Corp., New York.

Write for your free copy of the Klein Pocket Tool Guide today!

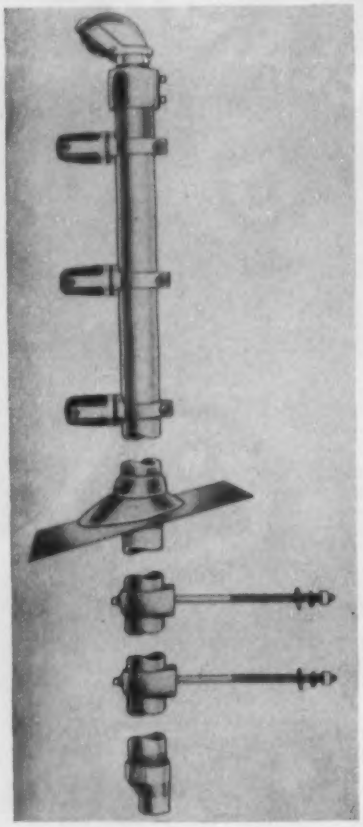
Since 1857

Mathias KLEIN & Sons

3200 BELMONT AVE. CHICAGO 18

age at 500 or 1000 v per second. Electromagnetic clutch permits disengagement at any point. Manual control knob may also be used to regulate voltage. Output is from 0 to 130 v, 60 cps.

Industrial Instruments, Inc, 89 Commerce Rd, Cedar Grove, N. J.



Service Entrance

A complete service entrance mast assembly is designed for low-roofed ranch-type buildings. Mast, a 7-ft length of 2-in. galavanized pipe with necessary fittings, may be enclosed in construction or mounted on exterior.

Blackhawk Industries, 250 S. Main St, Dubuque, Iowa.

Variable Speed Drive

A stepless adjustable-speed drive, the Electronic Select-A-Spede, is designed for operation from an ac circuit and has dc drive motors in sizes ¾ to 15 hp. Speed ranges are as high as 100:1. When used with optional tachometer feedback equipment the regulation is ±0.5%.

Unit consists of anode transformer, electronic control panel, pushbutton station, and an adjustable-speed dc drive motor. The drive is applicable to test equipment, machine tools, conveyers, balancing machines, paper machines, tire-building machines, and welding positioners.

Louis Allis Co, 427 E. Stewart St, Milwaukee 4, Wis.

Coming New Equipment

Received Too Late for This Issue

Unit-Supported Bus

General Electric Co—Is of isolated-phase design in lengths up to 16 ft

Straight-Line Clamp

Porcelain Insulator Corp—Is available in forged-aluminum or steel material

Cleaning Brush

A conductor cleaning brush for use with contact paste has durable thermo-setting plastic on handle for high dielectric protection. Brushes can be rotated or replaced with a standard screwdriver.

Jasper Blackburn Corp, 35 Madison St, St. Louis 6, Mo.

Megohm Meter

Type L megohm meters are designed for high-speed testing of insulation leakage in accordance with ASTM specification D-257-52T. Accuracy of resistance bridge is ±1.0% of full-scale current. Voltage across test piece is constant within ±0.1%. Built-in voltmeter assures accurate settings.

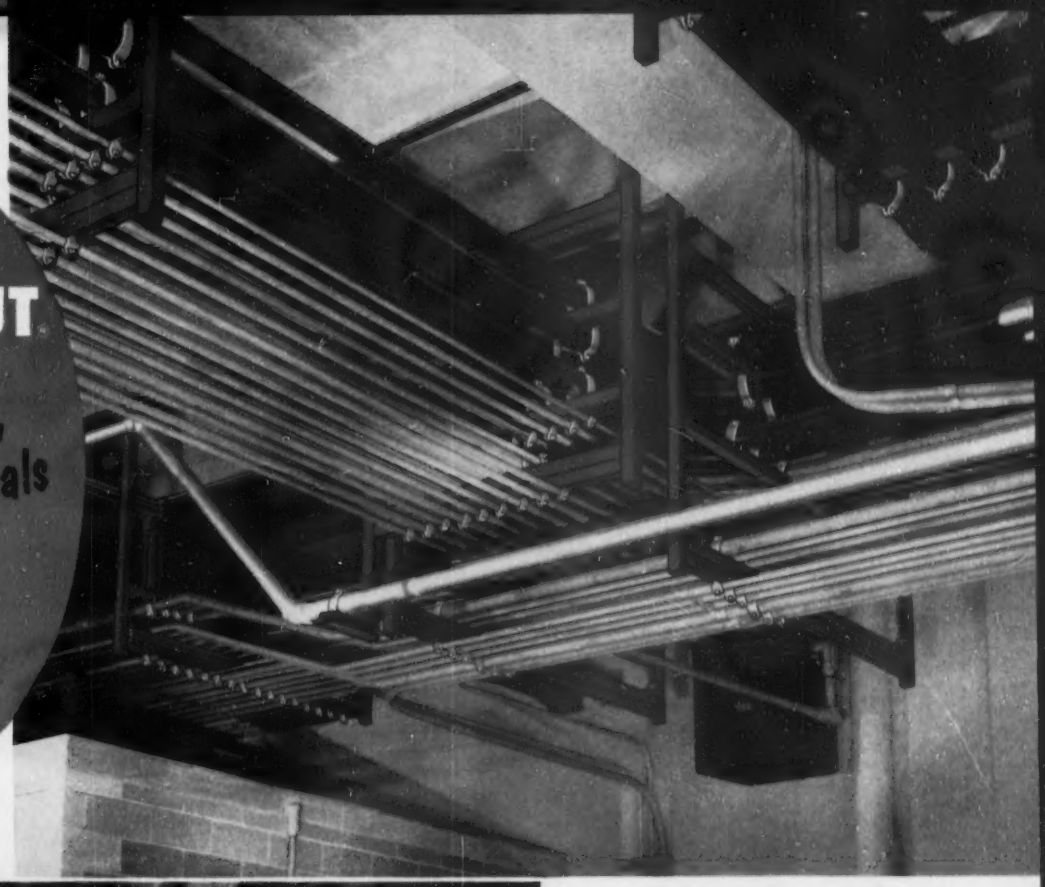
Scale is in megohms, and may be calibrated by built-in resistance standard. Internal power supply has balanced tube circuit and voltage regulators. Guard circuits eliminate surface-leakage errors. Meter is bench-type with sloping panel. Provision is made for extending the range of the instrument with external power supplies.

Three models are available, having test voltages of 200 v, 200 and 500 v,

UNISTRUT concrete inserts, steel channel, fittings and clamps support maze of conduit in trapeze style framework.

ADJUSTABLE UNISTRUT FRAMING

saves time, space, materials in large chemical plant



View shows how UNISTRUT nut and bolt assembly permits speedy erection, changes or additions at any time.

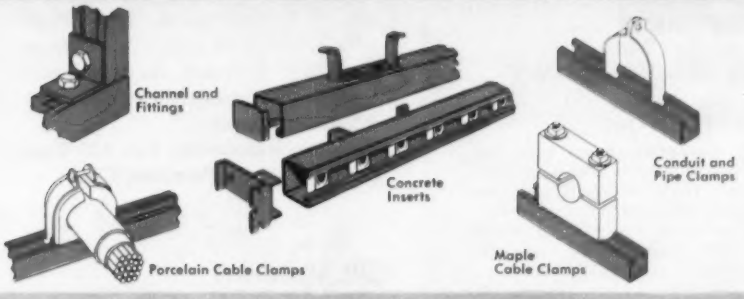
Conduit and Cable Installed Faster, Easier, for Less, at Kaiser Aluminum & Chemical Corporation's new Chalmette, La. plant

Versatile UNISTRUT steel structural supports reduce engineering detailing, permit rapid, on-the-job erection, allow changes or additions at any time.

This simple-to-assemble framing system consists of steel channel and fittings, clamps, brackets, hangers and concrete inserts—provides all you need to mount, frame, suspend or support all kinds of electrical equipment with just a hacksaw and a wrench.

No drilling, no welding, 100% adjustable and re-usable—there is no waste. Try UNISTRUT framing on your next job!

See our complete catalog in Sweet's Architectural, Plant Engineering and Industrial Construction Files.



UNISTRUT

THE WORLD'S MOST FLEXIBLE ALL-PURPOSE METAL FRAMING

Write for FREE 84-page Pocket Catalog No. 800
For the MAN ON THE JOB. Photos, drawings, ideas and data on how to frame, mount, rack and support electrical and mechanical equipment with UNISTRUT metal framing.

U. S. Patent Numbers
2327587 2329815 2346050
2363382 2380579 2400631
2541988 Other Patents Pending

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City _____ Zone ____ State _____

Preformed ARMOR RODS

Applied with a *TWIST of the wrist!*

Save Time, Labor

● **Preformed Armor Rods** are quickly and easily applied *by hand.* Their preformed spiral pitch tightly grips the conductor for a perfect, lasting fit. No special tools, clamps or clips are needed. By reinforcing the conductor at the supports, **Preformed Armor Rods** minimize breaks due to vibration fatigue. They also protect against flashovers and arcing, provide increased holding power, prevent abrasion and chafing, eliminate tie and clamp damage, increase radiation area and reduce corona losses. Designed and produced to accurate standards in Aluminum Alloy, Galvanized Steel, Bronze and Copperweld.

Preformed Aluminum Alloy Line-Guards

● Provide protection against wear and abrasion, especially where insulated wires pass through trees. Designed for use with self-supporting service-drop cable . . . also available for covered single conductors. *Ask your Graybar representative for details!*

INDIANA STEEL & WIRE CO.
Muncie, Indiana

and continuously variable between 200 and 500 v.

Industrial Instruments, Inc, 89 Commerce Rd, Cedar Grove, N. J.

Limit Switch

A versatile machine tool limit switch, Class 9007 Type T, may be adjusted with a screwdriver to obtain eleven different contact operating sequences. Different operating lever arms are available which can be mounted in any angular position. Small travel operates the switch. Approximately 80 deg overtravel is provided in either direction.

Diecast enclosures are gasketed with neoprene, making them watertight, oiltight, and dust tight. Mounting can be in a variety of positions.

Square D Co, 4041 N. Richards St, Milwaukee 12, Wis.

Expanded Scale Voltmeter

Expanded scale ac voltmeter, Arga Model 101, measures 100 to 500 v rms, 50 to 2000 cps, in 39 10-v steps, with accuracy of ±0.25%. Connections are provided for continuous recording of voltage fluctuations with a 1-ma dc recorder.

Beckman Instruments, Inc, 220 Pasadena Ave, South Pasadena, Calif.

Dc Meters

A line of miniature portable dc instruments, Model 281, with 1% accuracy incorporates a self-shielded mechanism. Close proximity to magnetic materials does not affect ac-

(Continued on page 182)

makes CORE and STRAND Share the Load

Once the two-bolt clamp is tightened on the Reliable No. 420 Snub Deadend, both the steel core and the aluminum strand carry their full share of the load. There is no slippage that throws all the load on the aluminum strand. The two-bolt clamp is simple to tighten and subjects the ACSR to a minimum of vibration fatigue. This deadend is approved for use without armor tape. No. 420 ACSR Snub Deadend has the added advantage of being extremely light in weight. Many thousands of these deadends are giving unobtrusive yet unfailing service.

Reliable

ELECTRIC COMPANY

3145 CARROLL AVENUE
CHICAGO 12, ILLINOIS

OVER 45 YEARS OF SERVICE TO THE UTILITIES

POWER-LINE CONNECTORS and CONSTRUCTION SPECIALTIES

READY TO START moving the 750-kva General Electric network transformer, with submersible protector, from trailer to vault. Notice the room air-conditioning units in the windows—one of the reasons why more capacity is needed here.

Potomac Electric, Washington, D.C., installs G-E network unit to meet extra-heavy load demands

System reinforced with 750-kva G-E transformer and network protector

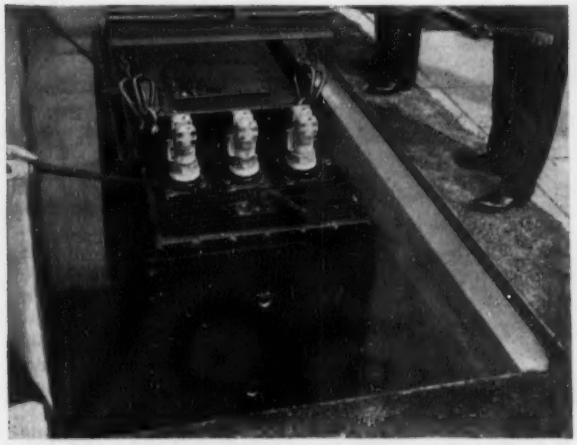
The flexibility and ease of expansion provided by a secondary network system certainly "pays off" for Potomac Electric Power Company in downtown Washington, D. C. Flexibility of the system permits load growth additions with minimum interference to service in the highly concentrated downtown area.

The financial district is experiencing a phenomenal growth and the consequent heavier load requirements, including air-conditioning in existing buildings in the area, necessitated installation of this 750-kva G-E network transformer. The unit, equipped with a submersible automatic network protector, is located at 730—15th Street, N. W., directly in front of the American Security and Trust Company building.

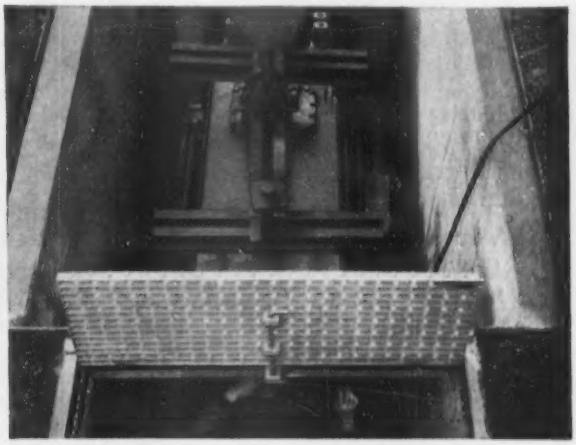
Compactness of G-E network units permits minimum vault depth (7 feet to roof slab) for lower installation cost.

It pays to start a network. Although the change from a radial to a network system means substantial initial expense, future increases in capacity require less investment with a network system. With a growing load, the sooner the network system is started, the lower the ultimate cost. Why not investigate the advantages for your system?

For help in solving your network problems, and for complete information on the many advantages of G-E standardized network units, get in touch with your nearest G-E Apparatus Sales Office, or write for Bulletin GEA-5024, General Electric Company, Section 431-201, Schenectady 5, N. Y.



ALMOST IN PLACE and with minimum inconvenience, even in a congested downtown area. Note the G-E submersible automatic network protector on the low-voltage end of the transformer.



CENTERING UNIT in vault prior to cabling. Convenient location of cable terminals on G-E units makes minimum size vaults practical—simplifies connections for fast installation.

You can put your confidence in—

GENERAL ELECTRIC

ACCO Registered* WIRE ROPE SLINGS

A STANDARD OF QUALITY

●"ACCO *Registered*" is the registered trademark applied by American Chain and Cable Company to slings of the highest grade, but it is more than just a trademark.

"ACCO *Registered*" is a definite specification of quality in both material and design.

To be "ACCO *Registered*," a wire rope sling must meet the following specifications:

1. **It must be made from high strength "Green Strand" wire rope.**
2. **All parts of the finished sling must have a breaking strength equal to the catalog strength of the sling body.**
3. **All fittings and attachments must withstand a proof-test equal to at least two times the rated capacity without permanent distortion.**
4. **Actual field service tests of each design.**

As evidence of compliance with these requirements each sling is given a metal identification tag and is accompanied by a Certificate of Proof Test and Registry.

What does ACCO REGISTRY mean to you?

It means that you can equip your shop with "lifting tools" and be confident that their designs and materials are specifically selected for the highest efficiency by trained engineers who spend all their time on slings.

It means that you can be sure that your men, materials, and machines are given the highest protection against injury during lifting operations.

Where can you get ACCO REGISTERED SLINGS?

To make ACCO *Registered* Slings immediately available for your requirements, American Chain and Cable Company, Inc. has appointed one of the best industrial supply houses in your community as an ACCO *Registered* Sling distributor. Selection for such appointment is made on the basis of the distributor's desire to serve you, his grasp of your problems, and his willingness to maintain in his stock sizes and types of slings you need.

See your ACCO *Registered* Distributor or write to us for literature and his name.

*Trademark Registered

ACCO

Wire Rope Sling Department
AMERICAN CHAIN & CABLE

Wilkes-Barre, Pa., Chicago, Denver, Houston, Los Angeles, New York, Odessa, Tex., Philadelphia, Pittsburgh, San Francisco, Bridgeport, Conn.

plus Links Shackles Hooks

New Equipment

(Continued from page 178)

curacy. A conductor carrying 15,000 amp at 3 ft from instrument causes error of less than 1%. Large moving coil gives high torque-to-weight ratio and allows increased sensitivity where needed.

Bakelite cases withstand dielectric test of 2,000 v ac between case and terminals. Mirror and knife-edge pointers eliminate parallax errors on hand-calibrated scales. Various ranges in single and multi-range voltmeters, ammeters, and volt-ammeters are supplied. Dimensions are approximately 4½ x 4½ x 1½ in.

Weston Electrical Instrument Corp, 614 Frelinghuysen Ave, Newark 5, N. J.

MORE NEW PRODUCTS
about which you should know

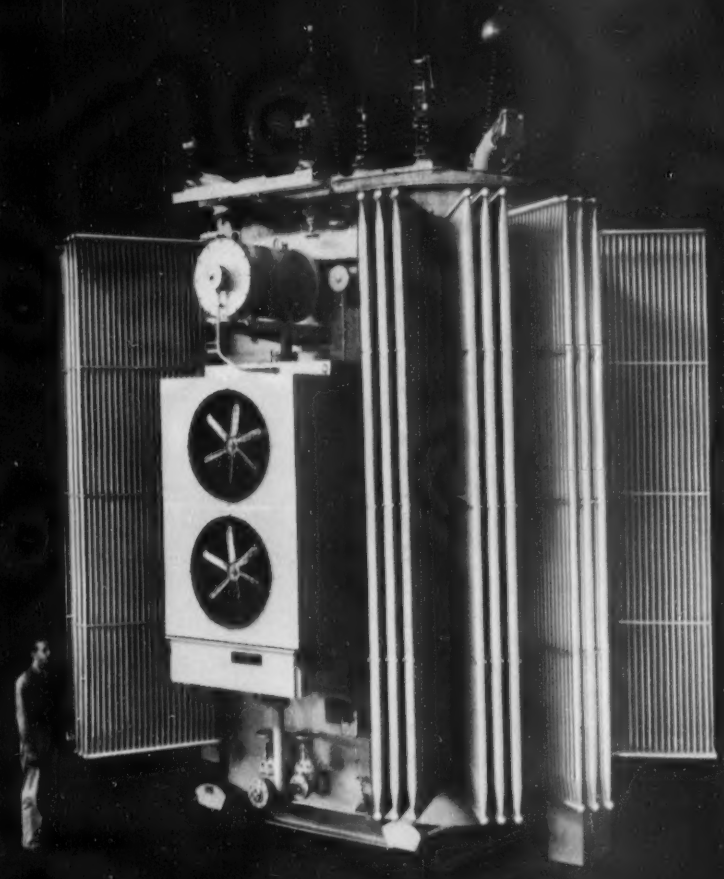
Reel-O-Matic Corp of America, Columbia, Pa., announces a ceiling-mounted, **power supply reel** having a 40-ft cable that can be lowered by push-button control . . . Square D Co, 6060 Rivard St, Detroit 11, Mich., has a **neutral circuit breaker** for use with XO load centers.

General Electric Co, 1 River Rd, Schenectady 5, N. Y., announces two instruments. **Current-integrating instrument** with moving-coil drive is rated −85 to +85 ma-sec, accuracy of ±2% for integrating random currents over 2-min period, responds to 0.03 to 6 ma. **Current-squared integrating instrument** has dyanometer drive, accuracy of ±3% for integrating random signals over 2-min period, responds to 1.5 to 30 ma . . . Minneapolis-Honeywell Regulator Co, 2753 Fourth Ave, S., Minneapolis 8, Minn. makes **null indicator,** claimed to speed resistance and potential measurements, utilizes precision potentiometers and bridges.

Electromode Corp, 45 Crouch St, Rochester 3, N. Y., makes surface-mounted **wall heater** for 1500, 2000, 3000, and 4000 w. Heater has fan-forced circulation, measures 21 x 17 x 5½ in. . . . Knox Chemical Co, 18 E. Kinzie St, Chicago 11, Ill., has Knox-All **weedkiller** claimed effective on all vegetation, any time of year.

41,667 KVA
SINGLE PHASE

PENNSYLVANIA POWER TRANSFORMER



Seven of these Pennsylvania power transformers are installed in two 125,000 Kva banks, with one unit serving as a spare. The transformers are designed to step down a transmission voltage of 110,000 volts. Each transformer has a capacity of 41,667 Kva when both forced-oil—forced-air heat exchangers are in operation. When only one of the heat exchangers is used, each transformer can be loaded to 33,333 Kva. Self-cooled, each transformer has a rating of 25,000 Kva.

Low Voltage windings are wound in two sections — each equal to one-half the rating of the High Voltage windings — and brought out through separate bushings.

See next page for inside story

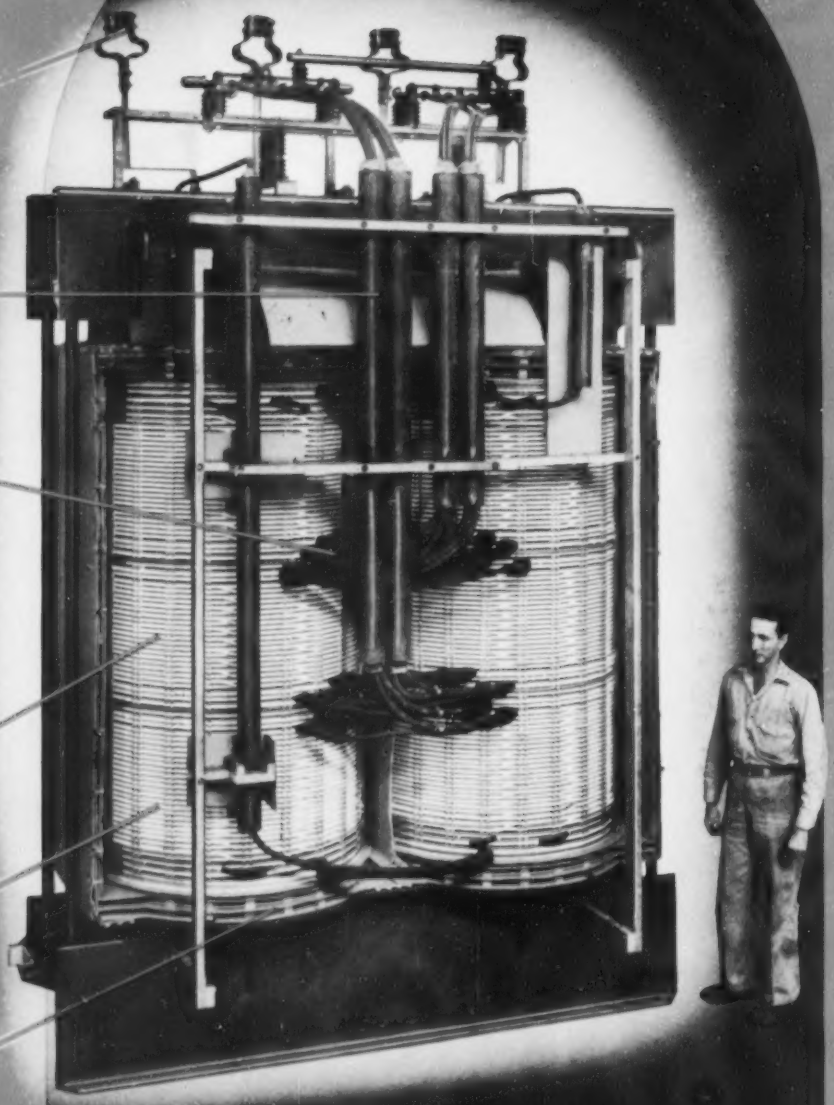
pt

PENNSYLVANIA TRANSFORMER COMPANY

A McGraw Electric Company Division

CANONSBURG, PENNSYLVANIA • *Greater Pittsburgh District*

Inside a 41,667 KVA, single phase PENNSYLVANIA POWER TRANSFORMER



Flexible Low Voltage bushing connectors.

Well-insulated tap leads, rigidly supported, are connected to Pennsylvania straight line no-load tap changers.

Two sets of taps per coil assure excellent electrical and mechanical balance in the windings.

Coils are precompressed with force equal to the highest short circuit stress and built into the transformer at that compressed dimension. This prevents mechanical distortion of the coils if short circuit stresses occur.

Continuous pancake winding in High Voltage coils. Helical winding in Low Voltage coils.

Extra heavy insulation at line ends of coils. Graded insulation at ground ends of coils.

pt

For exterior view of this transformer, see other side.

25,000/33,333/41,667 Kva. Single Phase, 60 Cycles, 55 C. Temperature rise. High Voltage: 110,000 volts. Low voltage: 7,950/13,800 volts.

PENNSYLVANIA TRANSFORMER COMPANY

A McGraw Electric Company Division

CANONSBURG, PA. *Greater Pittsburgh District*

RELAYMEN attending PEA committee meeting tour General Electric Co's Philadelphia plant. R. E. Cordray shows a new relay to (left to right) R. H. Jones, GE; I. D. Perry, Public Service of New Jersey; J. A. G. Oewel, relay committee vice chairman; and C. R. Joy, Ebasco

Pilot-Wire Relaying Discussed

Three papers dealing with effect of power system faults on communications operations presented at PEA committee meeting

The effect of power system faults on pilot-wire relaying was the subject of three papers at the recent Pennsylvania Electric Association Relay Committee at Philadelphia. Investigation of three failures of the pilot-wire link itself at Philadelphia Electric Co's Emilie substation opened the series. Analysis of test data by R. R. Peters disclosed that the potential difference between the two ends of the pilot pair is about 0.5 v per ampere of fault current. But properly installed neutralizing transformers provide adequate protection for telephone equipment, he added.

Disturbance Elminated . . . A fault on one 67-kv line of the Delaware Power & Light Co's system created a serious system disturbance when pilot relaying tripped three other lines, reported E. R. Detjen and H. Evans. Trouble was traced to failure of one gap in a carbon-block protector. Staged tests disclosed that potential difference between the ends of the pilot link can be predicted from ground impedances and fault capabilities. After such computations, said Detjen, this installation was corrected by substituting protectors of higher breakdown value.

Expensive staged tests to determine the resistance of station ground networks with heavy current flow are not necessary, asserted W. F. Dunkle, Pennsylvania Power & Light Co. He cited comparisons to prove that conventional tests with portable devices to driven probes at predetermined distances give reliable data. Ground potential of one large station could rise nearly 2,000 v during a 10,000-amp ground fault. Repetitive testing is required to maintain satisfactory ground values, he concluded.

The Research Problem . . . Luncheon speaker L. R. Gaty, manager of engineering, Philadelphia Electric Co, urged utilities take "a healthy attitude" toward criticism by educators. Statements that utilities neglect research fail to recognize that much manufacturer research is financed from sales to utilities, he said. But utilities must not show irritation. He said they should sell themselves to students and educators.

Real cause for concern is the decline in scientific teachers, continued Gaty. Between 1950 and 1953, graduates trained to teach science in preparatory schools has dropped from 9,100 to 4,600. Five to ten years of this trend can cripple scientific education, he said.

Blowing Out Piping

. . . prior to steam system operation given attention at EEI Prime Movers meeting

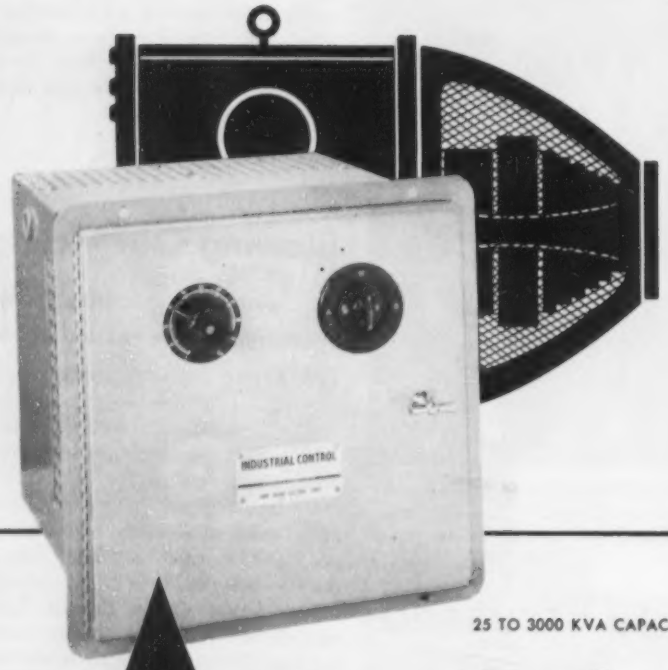
The removal of foreign matter from steam systems prior to initial operation has called for considerable resourcefulness on the part of operating companies. This was given a good deal of attention, Feb. 1-2, at the meeting of the Prime Movers Committee of Edison Electric Institute. Details of that committee meeting have just been released by the institute.

Blowing Out Preferred . . . Some companies have been using temporary steam strainers installed in the steam piping ahead of the turbine. But most companies have adopted the practice of carefully blowing out new steam systems including boiler parts. While steam is generally used as the scouring agent, one company reported use of compressed air for this purpose.

A motion picture made by Niagara Mohawk Power Corp showed that such quantities of piping scale, welding beads, welding rod butts, machining chips, and other extraneous material have been discharged during "free-blowing" as to make this practice necessary. To further insure that new boiler tubing is free from obstructions, another practice is to shoot sponges through the tubes of new steam generators with compressed air. Possible damage to the turbine or related equipment is avoided in event any sponges are left in the boiler because the sponges disintegrate in the heat of the boiler before reaching the steam strainers.

Increased Use of Hydrogen . . . With modern generators operating at in-

Completely New Automatic Generator Voltage Regulator



25 TO 3000 KVA CAPACITIES

THE "Autostatic" BY LAKE SHORE

Here . . . for the first time . . . is a voltage regulator with no moving parts or electronic tubes to wear or fail. The new AUTOSTATIC regulator eliminates maintenance expense, yet costs no more than comparable mechanical units.

In addition, the AUTOSTATIC operates with a speed and accuracy impossible to units having moving parts. It reacts almost instantaneously to correct voltage fluctuations caused by changes in the generator load. There is no time lag because of inertia and friction. Output fluctuations are reduced to a negligible quantity, both in magnitude and duration.

The AUTOSTATIC is available in three sizes with capacities of 25 to 100 KVA, 100 to 400 KVA, and 400 to 3000 KVA.

1869-LS

Write today for Bulletin 1517.

Lake Shore

ENGINEERS • DESIGNERS • FABRICATORS

LAKE SHORE ELECTRIC CORPORATION
225 WILLIS STREET • BEDFORD, OHIO

creased hydrogen pressures the quantity of this gas used by the electric power industry has increased markedly during the past few years. One company found that 10,000 cylinders of hydrogen are handled in the servicing of its stations each year. Handling methods are being simplified at some stations by the installation of permanent cylinder racks or large bottles in the station yards that can be refilled from the vendor's trucks. One company has provided dollies for handling the cylinders, each of which accomodates 12 bottles. The hydrogen vendor delivers the bottles carried by the dollies. Not only does this method reduce handling, but it also eliminates the hazardous practice sometimes employed by hydrogen vendor employees of bouncing filled bottles off from delivery trucks. The 12-bottle dolly is handled by a crane.

New Study Group . . . With hundreds of thousands of dollars being invested in instrumentation and control in each modern large station, the committee is considering the establishment of a subgroup to study and analyze current control and instrument practices and the problems associated with them in power station design and operation. A temporary subcommittee was named under the chairmanship of William Welch, Long Island Lighting Co, to survey and report on this matter.

Soot blowing methods and installations will receive increased attention from the boiler auxiliaries subcommittee. A discussion of practices in regard to this equipment suggested the possibility that the optimum number of blowers had been exceeded in some cases. The subcommittee is under the direction of Stanley Moyer, Philadelphia Electric Co.

Power station fire control practices are being reviewed by the turbine and condensers subcommittee and the fuel and ash handling subcommittee is considering trouble experienced in coal handling systems where hard-to-handle fuels are involved.

KU to Start Work on Plant

Kentucky Utilities Co expects to start construction in 90 days on a steam-electric plant at Dix River Dam near Lexington, Ky. The project will be built in four units and will have an ultimate capability of 424,000 kw.

This booklet tells how . . .

This 32-page booklet can help you build or repair apparatus, to operate better at lower cost. Gives properties and advantages, test data, construction drawings, case histories, application details. Also describes the board products and composites.

Quinterra® and Quinorgo® Electrical Insulations lengthen service life...simplify production...cut costs

Quinterra is the pyrolysis-resistant dielectric that helps cut electrical apparatus costs. More and more manufacturers are using it to make apparatus smaller and safer, at lower cost. Its composites are being used in Class "B" and Class "H" motor rewinding. It permits equipment to operate at higher temperatures because it remains a dielectric despite heat and time . . . the bulk of its dielectric strength is in the purified asbestos base sheet. Its mechanical strengths, thinness and flexibility permit economical application.

Quinorgo is the moderate priced, high temperature insulation for use alone or in composites. Designed for operating temperatures up to 130C, it combines high dielectric and mechanical strengths. High in absorption capacity, it can be readily treated and combined with other dielectrics. Furnished only in untreated form.

Send for your free copy now! This new booklet is offered without obligation to electrical equipment designers, engineers, manufacturers and motor repair shops.

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ELECTRICAL INSULATIONS

Johns-Manville, Box 60, New York 16, N. Y.
In Canada, 199 Bay St., Toronto, Ontario.
Please send me without charge copy of booklet EL-40A, "Pyrolysis Protection Pays Well."
My company ☐ makes equipment ☐ repairs equipment

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Company_____

Street_____

City & Zone_____ State_____

rotary multipole switch
ESCO TYPE-A

The ESCO Type-A Rotary Switch is a compact, multipole switch for tap, transfer, and selector service.

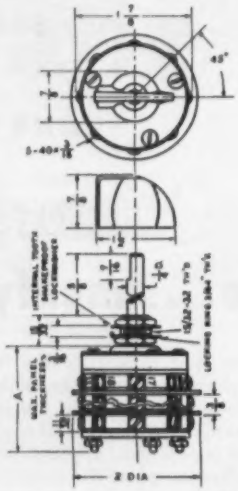
It can be furnished for continuous rotation, in both directions, through eight positions, or can be provided with movement limited to from two to eight positions. An important advantage of the Type-A switch is that it has an exceptionally sturdy detent mechanism that assures positive positioning of the switching elements at all eight positions.

Movable contacts carried on molded-phenolic rotors engage fixed contacts distributed around the circumference of recessed, molded-phenolic disks so constructed that the make and break action is wholly contained within an insulating enclosure. Assemblages of fixed and movable contacts to suit varied switching needs can be combined so that as many as seven different sections can be controlled by a single knob.

ELECTRICAL RATINGS — TYPE-A SWITCH

Service		Amperes	Volts
Continuous current		10 a-c/d-c	125
Interrupting	0.75 p. f. lamp load	5 a-c	125
		3 a-c	125
	non-inductive	5 d-c	30
		1 d-c	125

Heavy-duty rotary switches rated at 10, 30, 60, 100, or 200 amperes are also available from ESCO. Bulletins giving detailed specifications on all ESCO switches will be furnished on request.



SECTIONS	DIM. A	APPROX. WEIGHTS
1	1 1/16	3 oz.
2	1 7/16	4 oz.
3	1 13/16	5 oz.
4	2 3/16	6 oz.
5	2 9/16	7 oz.
6	2 15/16	8 oz.
7	3 5/16	9 oz.

ELECTRO SWITCH
CORPORATION
167 King Avenue Weymouth 88, Mass.

California-Pacific, BPA Negotiating Power Pact

California-Pacific Utilities Co is negotiating with Bonneville Power Administration for a 20-year contract to obtain Columbia River federal power for its system through a new transmission line the company plans in its Oregon division.

Leon Gray, district manager at Baker, Ore., reported the company negotiations with BPA were in the final stages in early March. Plans call for Calpac to construct a 69-kv transmission line from BPA's substation at La Grande to the Calpac substation in Baker. Cost plus switching equipment is estimated in excess of $50,000.

The contract would result in maximum utilization of the federal transmission agency's new substation at La Grande. Calpac is one of nine private utilities eligible for long-term contracts with the agency and conclusion of negotiations would make it the seventh private utility to sign for long term BPA power delivery contracts since the Eisenhower Administration took office.

POWER BRIEFS

● Arizona State Power Authority is interested in buying 1,000 miles of feeder transmission lines inside the state from Interior Department. Interior officials are ready to consider any deal that will assure full repayment of federal investment. Arizona now is preparing a proposal.

● Second 18,000-kw generating unit has gone into operation at Tennessee Valley Authority's Fort Patrick Henry Dam on the South Fork of the Holston River, near Kingsport, Tenn.

● New Brunswick Electric Power Commission plans to start work on the $40-million Beechwood hydroelectric project on the St. John River next summer.

● National Rivers and Harbors Congress will resume this year its national conventions which were suspended during the Korean conflict. The 41st Congress of the group will be held May 25-26 in Washington, D. C., to discuss problems of flood and drought control.

● Preliminary work on the Diablo

(Continued on page 207)

BIDDLE *Instrument News*

- ELECTRICAL TESTING INSTRUMENTS
- SPEED MEASURING INSTRUMENTS
- LABORATORY & SCIENTIFIC EQUIPMENT

JAMES G. BIDDLE CO., 1316 ARCH ST., PHILADELPHIA 7, PA.

INSPECTION TESTING WITH A DUCTER® LOW RESISTANCE OHMMETER

The S & C Electric Company, of Chicago, manufacturers of high voltage protective and interrupting equipment use the Ducter Low Resistance Ohmmeter for all final inspection resistance checks of their power fuses.

This resistance check is made for two purposes—it shows whether the correct fusible element has been assembled into the power fuse, and gives an indication of any loose connections or high resistance joints within the fuse.

The fusible element of the S & C power fuses is a helically coiled piece of hard-drawn silver wire. Since the diameter of this wire varies only slightly from one rating of power fuse to the next, there is a chance of error in assembling the fuse.

The resistance check will detect such an error.

Since the average power fuse contains several metal-to-metal joints, either swaged, riveted or screwed, there is again the possibility of an imperfect joint which the resistance check with the Ducter Ohmmeter will detect. A typical value of resistance is 1.1 milliohms on which a tolerance of plus-or-minus .2 milliohms is allowed.

Whatever your low resistance measuring problem it will pay you to investigate the Biddle line of low resistance ohmmeters. For a complete file on these instruments write for BULLETIN 24P1-W.

BIDDLE "TTR" SETS SAVE DAYS OF TIME IN TRANSFORMER TESTS

Everywhere Biddle Transformer Turn Ratio Test Sets are performing a unique service in measuring turn ratio in transformers to high precision. By means of the "TTR" Set, transformer problems are analyzed quickly and easily. In many cases, one man with a portable instrument can make an average test in less than 15 minutes wherever the transformer stands. Often, based on fault information supplied by a "TTR" test, the shop can start winding new coils before the transformer is untanked and shipped in. Users also save valuable time making acceptance tests on new transformers. Here are just a few of hundreds of companies who have profitably invested in one or more Biddle "TTR" Sets . . .

Partial List of "TTR" Users

Westinghouse • Penna. Transformer Co. • Duke Power Co. • Consolidated Edison Co. of New York • Pennsylvania Electric Co. • Detroit Edison Co. • General Electric • Philadelphia Electric Co. • Allis Chalmers Mfg. Co. • Alabama Power Co. • Oak Ridge National Lab. • Ebasco International Corp. • Metropolitan Edison Co. • Boeing Airplane Co. • Tennessee Valley Authority • Florida Power Corp.

Write for BULLETIN 55-W.

FRAHM® RESONANT REED RELAYS AND OSCILLATORS

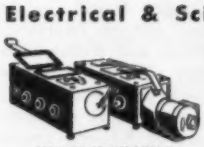
for Controlling Signaling Monitoring Protection and Frequency Matching

Frahm Resonant Reed Relays and Oscillators . . . form a team to help you on many electrical control and signaling problems. Typical control applications include: under or overspeed protection for motors, turbines, generators; wired music; street lights; door openers, etc. Signal applications include: selective calling in communications; intercoms, etc.; frequency matching of auto horns, telemetering of remote information, power line outage monitoring, etc. Write for BULLETINS 33-W and 34-10-W.

JAMES G. BIDDLE CO.

B-410

Electrical & Scientific Instruments • 1316 Arch Street • Philadelphia 7, Pennsylvania



MEGGER INSULATION RESISTANCE TESTERS

DUCTER LOW RESISTANCE OHMMETER

MEG-TYPE MEGGER INSULATION TESTER

MIDGET MEGGER CIRCUIT TESTER OHMMETER

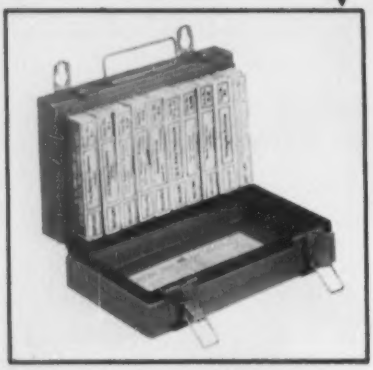
BIDDLE IMPULSE CABLE FAULT LOCATOR

MEGGER LOW RESISTANCE OHMMETER

"TTR" TRANSFORMER TURN RATIO TEST SET

Why buy all this ↓

when you need only this ↓



Hundreds of dollars are being saved yearly by users of Bullard First Aid Kits. Bullard's wide selection of standard kits planned to meet the accident patterns of specific industries means you get the benefits of custom designed kits without paying premium prices. Write today for the new Bullard First Aid catalog . . . discover how you can save spoilage and waste resulting from unused and unnecessary first aid supplies.

Send me your new folder, *"Custom Designed First Aid at standard prices."*

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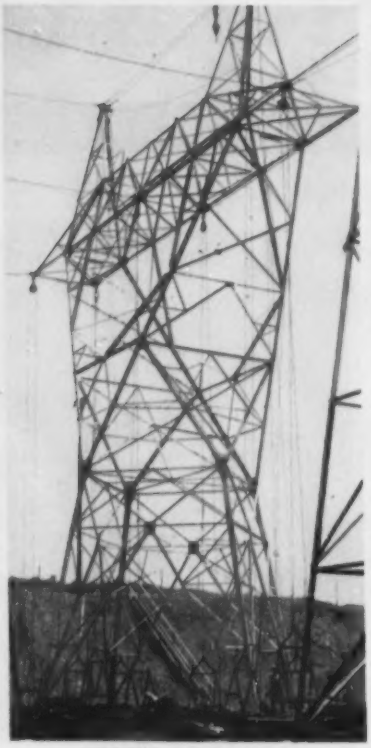
EVERYTHING BULLARD IN SAFETY

LETTERS TO THE EDITOR



It's McNary-Ross', Not Chief Joseph's

To the Editor:

I call your attention to an error which crept into the third paragraph of my article "Full-Scale Tests Prove BPA's 345-kv Tower Design" on page 82 of your Feb. 8 issue. It is the McNary-Ross line which is predominantly of single circuit construction, while the Chief Joseph-Snohomish line is of mixed, single and double-circuit construction. The statement as printed reverses this relationship.

Also in the same paragraph, the statement that "these lines ultimately will carry 450 Mw apiece" should have included the phrase "per circuit."

A. A. Osipovich, Engineer
Bonneville Power Administration
Portland, Ore.

A Sense of Values

To the Editor:

Your editorial, "Sure! It Will Sell" in the Jan. 25 issue interested as well as amused me. While I am entirely in accord with your argument that people will buy electric house heating, even in states as cold as Connecticut, I believe that your comparison with the purchase of $50 coffee pots was too conservative.

I am enclosing a clipping from the New York Times of Jan. 25. It tells of the sale of an antique coffee pot for $1,300. If somebody will pay that much for a coffee pot, there must be a lot more who will spend that much or more for something far more useful, electric house heating.

John A. Short
New Preston, Conn.

Required Reference

To the Editor:

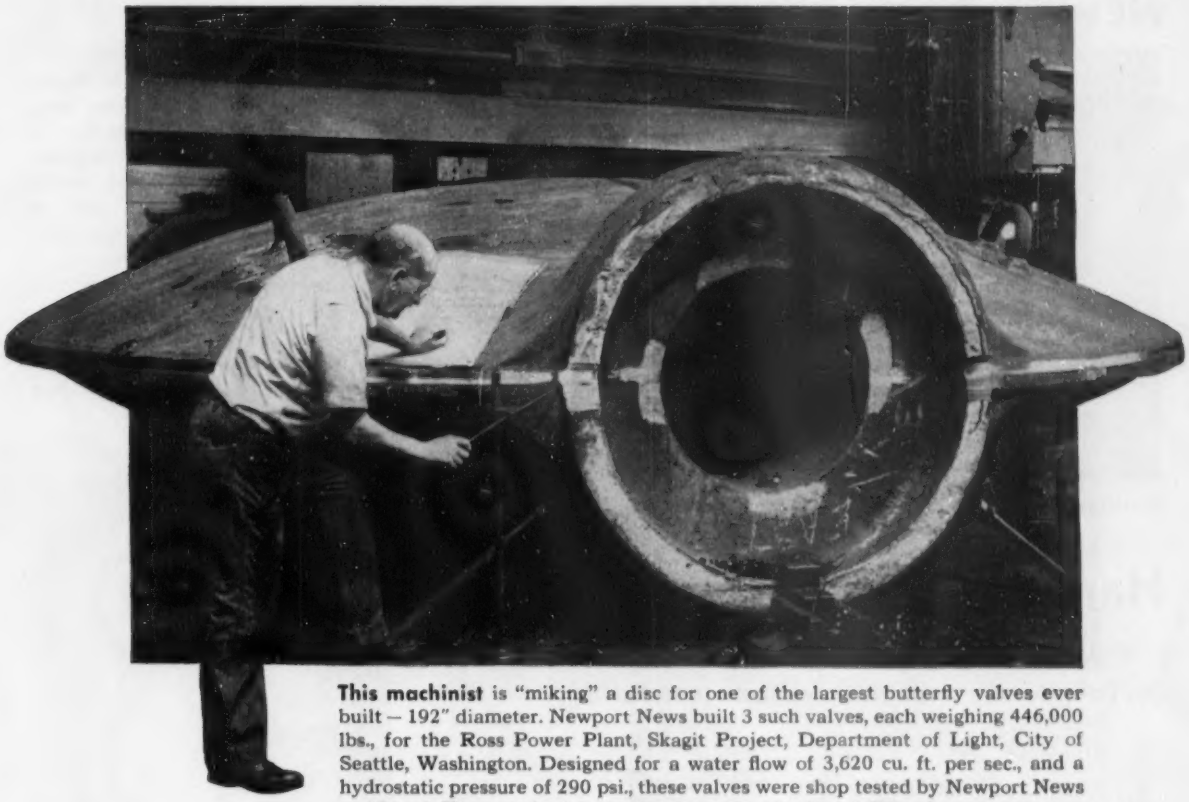
In answer to Mr. Miller's letter in the Feb. 8 issue about the relative hazard of 440 v as compared with 2300 v, I would refer him to Electronics magazine of July, 1944. The article is entitled "Effect of Electric Shock" by N. A. Poenler, Westinghouse Electric and Manufacturing Co, and is required reading in our plant.

The particular question of lethal results vs ac potential is covered as follows: the susceptibility increases with current to a maximum, and then decreases as the current is increased further. This is due to the phenomena of ventricular fibrillation and respiratory shock. There are many other conditions such as duration, frequency, resuscitation procedures, etc, that may effect the final result.

Donald McClellan
Electronic Engineer
Edgerton, Germeshausen & Grier, Inc
Boston, Mass.

Jubilee Issue April 5

EW has dedicated its April 5th issue to Light's Diamond Jubilee. It will contain among other things picture interviews with Charles E. Wilson and Walter Sammis on the Jubilee's significance and a roundup of what power companies all over the country are doing to celebrate the 75th anniversary of Edison's invention of the incandescent lamp.



This machinist is "miking" a disc for one of the largest butterfly valves ever built — 192" diameter. Newport News built 3 such valves, each weighing 446,000 lbs., for the Ross Power Plant, Skagit Project, Department of Light, City of Seattle, Washington. Designed for a water flow of 3,620 cu. ft. per sec., and a hydrostatic pressure of 290 psi., these valves were shop tested by Newport News at 450 psi. They are hydraulically operated with oil at 1,500 psi. pressure.

Birth of a **200-ton** Butterfly

This disc for a 16-foot butterfly valve reflects two basic advantages of Newport News fabrication...

First, it exemplifies the *careful attention* Newport News craftsmen give to every detail. And secondly, it attests to the *quality* with which Newport News produces in massive equipment for public utilities and allied industries... due to Newport News' high integration of skill and production facilities.

Additional advantages accrue to customers from extensive work conducted in Newport News' testing laboratories on problems related to water power equipment.

Avail yourself of the engineering talent, along with the specialized production techniques and the skill of Newport News craftsmen operating vast steel fabricating shops, five huge machine shops, drop forging and die facilities along with acres of brass, iron and steel foundries.

Let us bid on equipment for your present or future projects. If you are not familiar with the way Newport News can help you, write for our illustrated booklet entitled "Water Power Equipment" ...it's yours for the asking.

NEWPORT NEWS

Shipbuilding and Dry Dock Company
Newport News, Virginia

RAYMOND A. GIBSON

H. B. CAREY, JR

Hartford Electric Changes . . .

. . . linked with Connecticut Power appointment. Gibson, Carey, and Douglass are made vice presidents in reshuffling

Promotion of several top level executives has been announced by Hartford Electric Light Co and its affiliate, Connecticut Power Co.

Raymond A. Gibson, vice president of Hartford Electric Light, was named executive vice president of that utility. H. B. Carey, Jr, general counsel of the utility, was elected to the post of vice president.

Dwight Douglass, assistant vice president of both companies, was appointed vice president of Connecticut Power. He succeeds Vice Pres Fred D. Knight, who has retired after 13 years' service with both utilities.

DWIGHT DOUGLASS

Douglass, however, will remain as power production consultant for Hartford Electric Light.

Hartford's 2 VP's . . . Gibson, an electrical engineering graduate of Rensselaer Polytechnic Institute, started his service with Hartford Electric in 1923 when he joined the sales department. He has served as advertising manager, commercial manager, and assistant to the vice presidents. He was made sales manager in 1945, advancing to vice president in 1950. Last year he was elected a director of the company.

Carey attended Yale College and was graduated from Yale Law School in 1940. He was associated with the law firm of Buck & McCook, Hartford, Conn., until 1945, when he entered into partnership with William W. Hoppin, Jr, and Robert H. Powell.

Connecticut Power's New VP . . . After graduating from Rensselaer as an electrical engineer, Douglass served as an instructor there before joining Hartford Electric Light in 1920. Douglass was made superintendent of power in 1941 and production manager ten years later. He has been assistant vice president of Hartford Electric Light and Connecticut Power since March, 1953.

A native of Limerick, Maine, Knight was graduated from the University of Maine with a B.S. degree in electrical engineering. After long service with Boston Edison Co as assistant superintendent and superintendent of production, he joined Hartford Electric Light in 1941 as assistant to the then vice president, T. H. Soren. Upon Soren's retirement in 1947, Knight became vice president in charge of operations, engineering and construction for Hartford Electric Light, and of engineering and power plant operation for Connecticut Power.

A. H. BRUNING

Georgia P&L Appoints Bruning Vice President

A. H. Bruning has been appointed a vice president of Georgia Power & Light Co with headquarters at Valdosta, Ga. Bruning, formerly director of industrial development for Florida Power Corp, will handle industrial development for Georgia P&L, a subsidiary of the Florida utility.

Bruning is a veteran of 26 years in the electric industry. After graduating from Stevens Institute of Technology, he served seven years with General Electric Co's lamp development department.

Then for ten years he was with Dallas Power & Light Co and South Carolina Gas & Electric Co. In 1937 he joined Florida Power Corp, serving as commercial manager until called to active duty with the Army Corps of Engineers. He returned to Florida Power in 1946 as assistant director of industrial development department, advancing to director in 1950.

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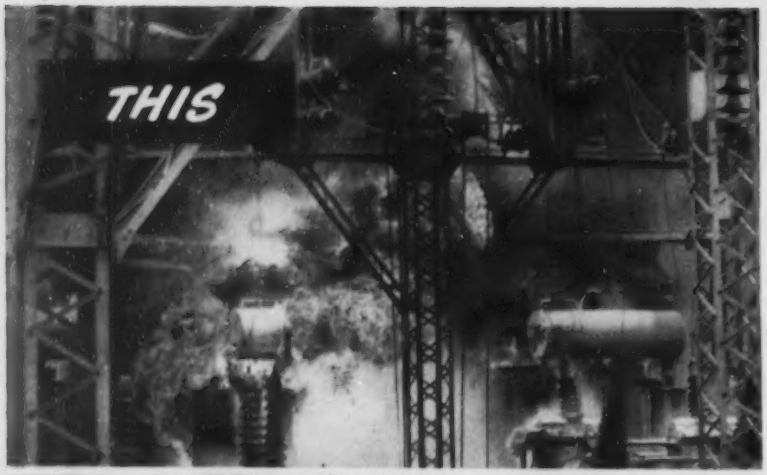

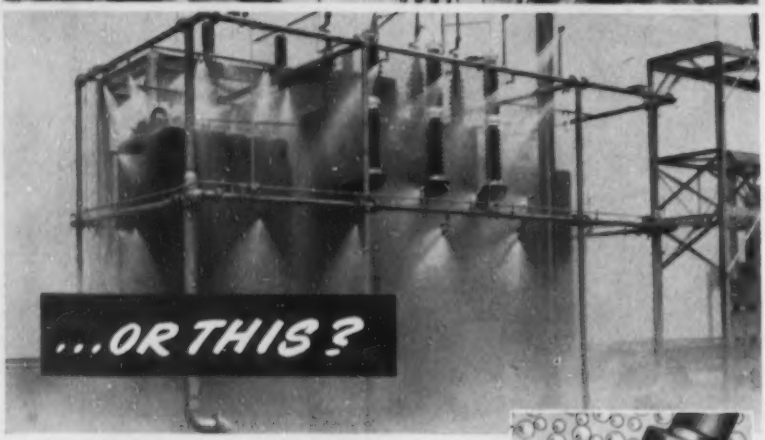

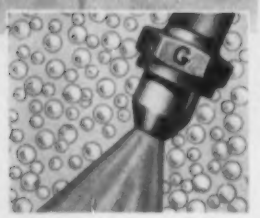

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Duquesne Light Reveals New Personnel Changes

Duquesne Light Co has announced new appointments for its fiscal, sales, and operating divisions.

Howard W. Staas was elected secretary of the company and E. G. Knoch was elected assistant treasurer. Staas, formerly assistant secretary in the secretary's department, will report to the vice president of the fiscal division and Knoch will report to the treasurer.

Sales Appointments . . . D. W. Loucks, E. J. Kelly, and Wayne Kunde were appointed directors in the commercial sales department. Loucks was director of industrial sales and steam sales. Kelly and Kunde formerly were supervisors in the commercial sales department.

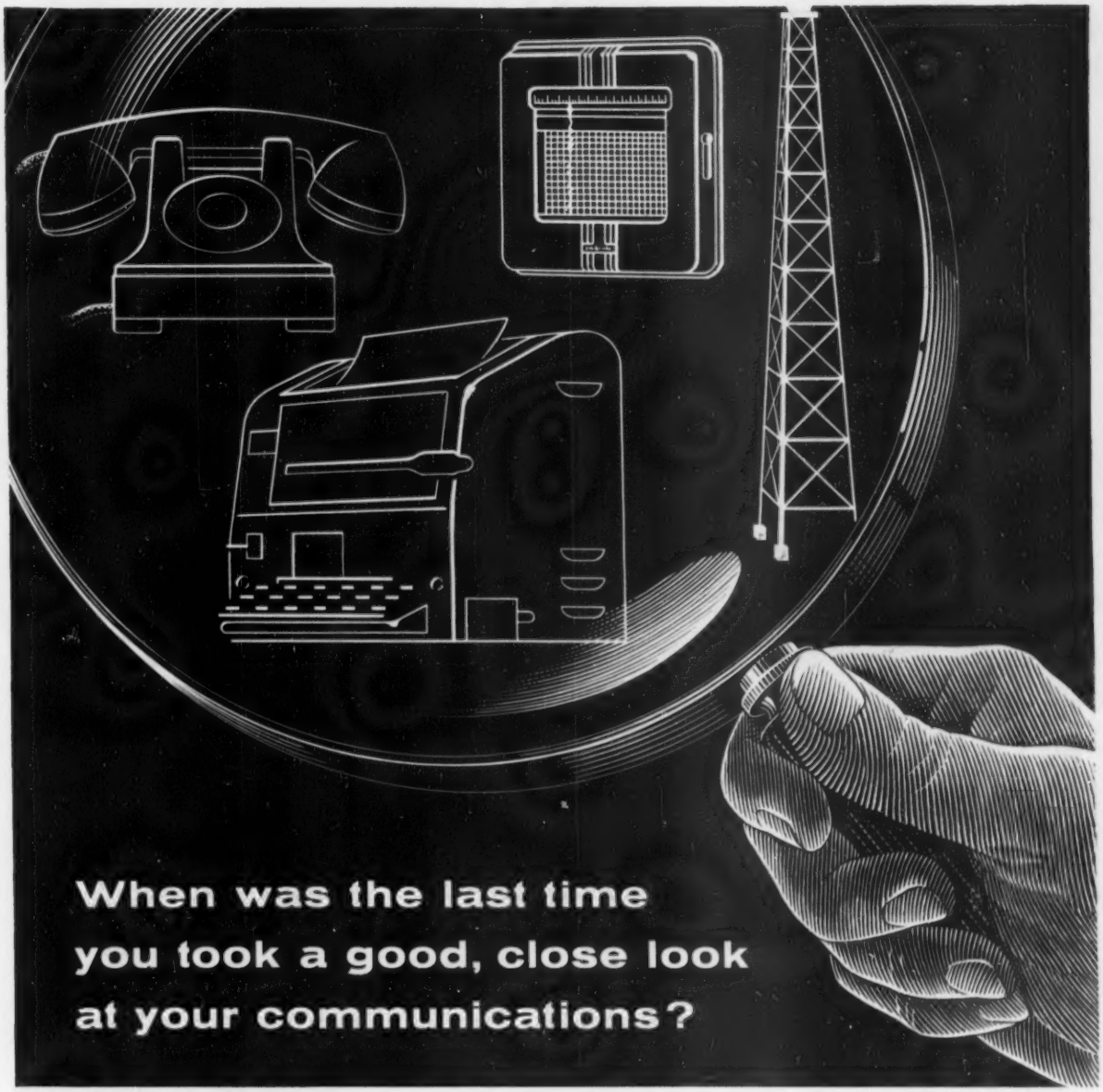
John B. White, Jr., was named manager of the customer service department and C. V. DeWitt was designated director of the industrial sales division. Alex E. Hunter, formerly a power engineer in the utilization division of the industrial sales department, was made supervisor of sales promotion in that department.

Power Station Assignments . . . D. B. Demond, David L. Detwiler, John L. Feller, Robert D. Nelson, Thomas Richardson, and Louis J. Spisak were assigned to new posts in the power stations department.

Demond was appointed office manager and Detwiler was made manager of the steam heating section. Feller was appointed chief engineer of the Twelfth Street Heating Plant and Nelson was named chief engineer of the Stanwix Street Heating Plant. Feller and Nelson report to Detwiler.

Richardson was named supervisor of distribution system maintenance and Spisak becomes supervisor of system operation and metering section in Allegheny County Steam Heating Co. They will report to Detwiler.

Substation-Shops Dept . . . R. J. Salsbury is the new manager of the operating and tests section of the substation and shops department and K. W. Kayler assumes the post of manager of the maintenance and shops section of that department. In other department appointments, Kenneth C. Manwaring was made superintendent of shops, reporting to Kayler. Albert F. Phillips was named superintendent of tests, reporting to Salsbury.



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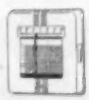
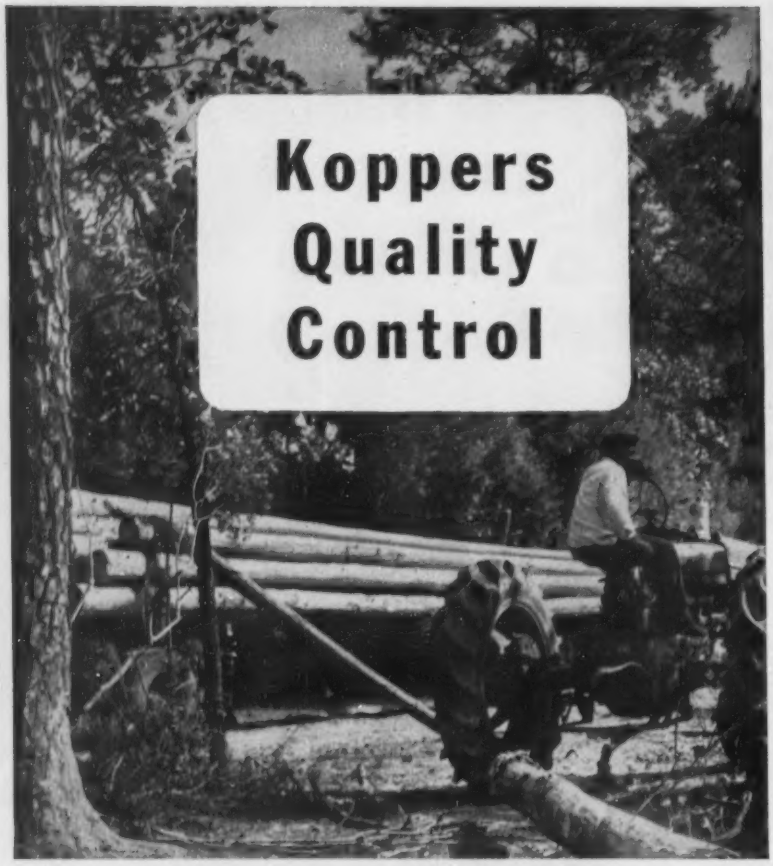

METERING CHANNELS

BELL TELEPHONE SYSTEM



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WILBUR H. RUESE

Wilbur Ruese Appointed to OVEC Engineering Post

Wilbur H. Ruese has been named superintendent of electrical operations for Ohio Valley Electric Corp. Ruese, a 36-year veteran in the utility industry, will direct electrical operations involved in supplying the power requirements for the Atomic Energy Commission's Portsmouth area project in Pike County, Ohio.

Ruese entered the utility field in 1918 when he became affiliated with Miami Valley Electric Co, Sidney, Ohio. Five years later he joined that firm's then parent company, Kansas Electric Power Co at Emporia, Kan. He was transferred to Lawrence, Kan., in 1926 and advanced by 1934 to vice president in charge of engineering and operations. He held these posts until the company was merged with Kansas Power & Light Co in 1949. He served that utility as chief electrical engineer until 1952.

•

Daniel Boone, treasurer of the Salt River Project Agricultural Improvement & Power District, Phoenix, Ariz., has been named to the newly created post of assistant general manager in charge of financing, business development, and sales. Other changes include the appointment of **G. W. Brandow,** general superintendent of power, to the new post of assistant general manager in charge of engineering, supply, construction, and operations. **S. G. Bazzill,** comptroller, was appointed treasurer of both the district and Salt River Valley Water Users Association. **Harry S. McCoy,** comptroller of the Water group, assumes the same post with the district.

OBITUARY

William Henry McGrath, 74, executive vice president of the Puget Sound Power & Light Co from 1914 until his retirement in 1931, died March 1 in Seattle, Wash. A 1901 Harvard graduate, he began his career as an electrical engineer with Stone & Webster at Boston, went to Houghton County, Mich., as electrical engineer and later became assistant general manager for the General Electric Co in Minneapolis. He moved to Seattle in 1913 as manager of Stone & Webster properties in that state, next year was elected vice president and manager of the Puget Sound Traction, Light & Power, predecessor of Puget Sound Power. McGrath had been a director of the Washington utility since his retirement.

Abraham L. Tyre, Jr, 60, sales engineer for M. W. Kellogg Co, New York, died March 8 of a heart attack enroute to work. He had been with the company 18 years.

Alexander M. MacCutcheon, former vice president of Reliance Electric & Engineering Co, Cleveland, Ohio, died March 4 at Orlando, Fla. He joined Reliance in 1914 and was made a chief engineer in 1917, a director in 1920, and vice president of engineering three years later. He retired in 1946. MacCutcheon, a fellow of the American Institute of Electrical Engineers, was awarded the Lamme Medal in 1948.

Walter R. Jones, professor of electrical engineering at Cornell University and an authority on design and construction of vacuum tubes, died March 8 at Ithaca, N. Y. He joined the Cornell faculty in 1948 after serving for 19 years with Sylvania Electric Products, Inc.

Thomas H. Yawger, 84, a pioneer in the use of electricity, died March 6 at Rochester, N. Y. He was affiliated with Rochester Gas & Electric Co and predecessors for 65 years, fourteen of them as general superintendent of electrical operations.

Henry G. Wells, 74, a member of the New Hampshire Public Service Commission and a former Massachusetts public utilities commissioner, died at Haverhill, Mass., March 5.

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British Firms Inch Up to Russia

Trade mission brings back $45 million in firm orders—30 to 40% of it in electrical equipment. More orders on the way

LONDON (McGraw-Hill World News)—Diesel generating sets, underground cable, transformers, and switchgear figured in contracts that a party of 33 British businessmen claimed to have brought back from Moscow last month.

Electrical equipment in all made up perhaps 30 to 40% of the £16 million ($44.8 million) in "firm" orders that the group said were negotiated during the visit. Further orders amounting to £48 million ($134.4 million) are said to be still under negotiation. (This month contracts for £3.5 million ($9.8 million) of this total were announced by British Oboe Group.) Among the suppliers to the electrical industry concerned in these are two or three cable companies and English Electric, Ltd.

Considerable propaganda may be involved in the figures. The Board of Trade says that "rather more than half" of the firm orders appears to fall outside strategic trade embargoes imposed on East-West trade by NATO countries. The BoT's implication is still that many orders may fail to get export licenses from the British government.

Propaganda a Factor . . . Propaganda is certainly a heavy item in Moscow's statements about what it would like to buy in Britain over the next three years. Soviet Foreign Trade Minister Kabanov put out a figure of £400 million ($1.12 billion). Last year British exports to Russia amounted to a measly $25.2 million.

In the electrical equipment field the Russians say they want to buy the following items in the U. K.: 110 power station generator sets of 500 kw, 1,000 kw, and 1,500 kw; 150 steam boilers at 20 to 30 tons; 20 5,000 kw power trains; 150 Diesel electric station sets of 310 kw and 865 kw; 50 air circuit breakers; and about $18 million worth of miscellaneous equipment. Transformers were mentioned but with no figures.

Present order—ones likely to go through—are much more modest. They include:

- R. A. Lister of Dursley, Gloucester: £750,000 ($2.1 million) worth of 410 kw Diesel generating sets and some £250,000 ($700,000) worth of spares for similar sets previously sold to the Russians.
- Crompton & Parkinson, Ltd, London: £700,000 ($1.96 million) worth of switchgear. Same company sold £500,000 ($1.4 million) worth of underground cable to the Russians last fall and is currently negotiating for more orders for this same type of cable.
- Another London company, not named, has agreed to supply £600,000 ($1.68 million) worth of substation equipment.

Other electrical and allied firms known to have representatives recently in Moscow are: Babcock & Wilcox, Blaw-Knox, Aberdere Cables, International Combustion, Johnson & Phillips, Lancashire Dynamo, Mullard Overseas, Ruston & Hornsby, South Wales Switchgears, and J. Stone & Co.

Intimate Knowledge . . . It was Crompton & Parkinson Ltd's sales manager, J. B. Scott, who organized the mission. Scott claimed that the Soviets "have an uncannily accurate knowledge of world prices."

Much electrical equipment is considered of great strategic importance under the present NATO embargo. Bare copper wire is prohibited. (Original Russian requests for underground cable in Britain were tied to shipments of copper wire.) There is a definite size limitation on all types power equipment.

The British government, pushed strongly by many industrialists including the cable manufacturers, is trying to get the list of embargoed items liberalized through NATO's joint East-West trade committee in Paris. This committee only makes recommendations—and only then if there is unanimous agreement. But the recommendations usually get approved by the respective governments.

Some members of the mission to Moscow deliberately contracted to sell items on the embargoed list. They plan to use the contracts as specific test cases before the Board of Trade to see if they can get the embargoed list liberalized.

Sammis Makes Coffin Awards Official

Walter H. Sammis, president of Edison Electric Institute and Ohio Edison Co, is shown at left signing citations given to five electric companies nominated to compete for the Charles A. Coffin Award for 1953, which will be presented at the institute's annual convention at Atlantic City in June. Ralph Cordiner, president of General Electric Co, donor of the award, looks on while he waits for his turn to sign the citation.

the story of the BIRDS and BEES

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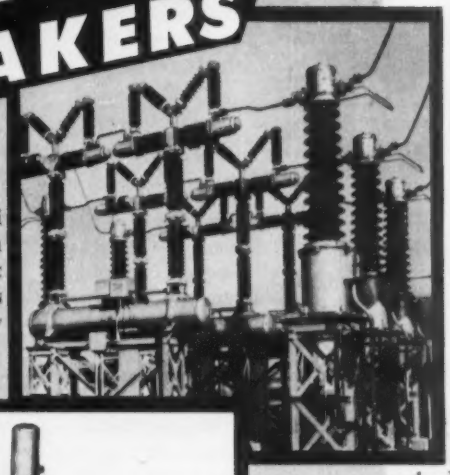
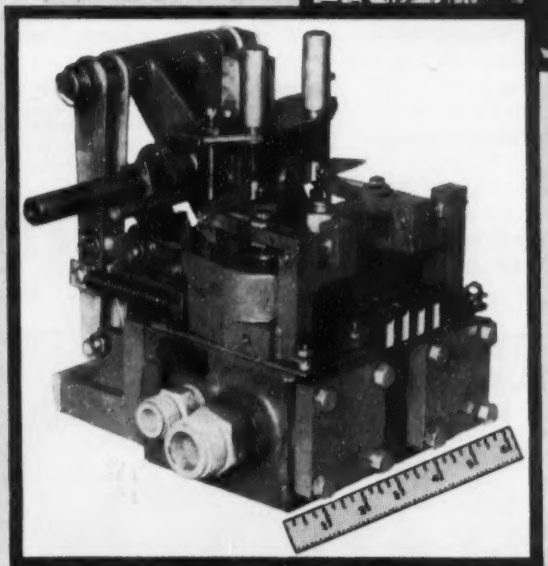


138 kV Brown Boveri Air Blast Breaker in sub-station of Public Service Electric & Gas Company of New Jersey.



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tions. These citations are designed "to broaden the importance of the main award and to further emphasize the significance of the achievements of the electric utility industry."

The citation winners, who can take the Coffin Award gold medal and $1,000 for the company's employee benefit fund, include the following: American Gas & Electric Co was cited for pioneering advanced engineering concepts; Cleveland Electric Illuminating Co, for its application of modern and progressive management principles and techniques; Connecticut Light & Power Co, for recognizing concept of utility's responsibility for contributing to community development; Texas Electric Service Co, for leadership in inaugurating water resource development program; and Wisconsin Electric Power Co, for its management selection and training program.

MANUFACTURING BRIEFS

Allis-Chalmers Manufacturing Co has formed a wholly owned subsidiary to be called Allis Chalmers, Great Britain, Ltd. The subsidiary will handle all Allis-Chalmers operations in the British Isles and in export markets served from the United Kingdom.

Pioneer Electric Co, Regina, Saskatchewan, will soon begin production of transformers at a new 10,000 sq ft, $150,000 factory in Regina. It will be firm's third plant in western Canada.

Roller-Smith Corp, 50-year-old Bethlehem, Pa., manufacturer of electrical equipment, has been purchased by the Mailman Interests. Management will be headed by Elmer T. Carlson, vice president and general manager, who retired from General Electric Co.

Westinghouse Electric International Co will assist Arabs in building and operating their first electrical appliance plant at Beirut, Lebanon. The company—Middle East Electrical Manufacturing—is to start with production of refrigerators in the spring of 1955 and will eventually turn out household appliances with a sales volume of $5 to $6 million annually.

SALES ASSIGNMENTS

COMPANY STAFFS

Minnesota Mining & Manufacturing Co named Ralph A. Henderson Dallas sales manager of electrical products and magnetic recording tape. He will supervise sales in Texas, Oklahoma, and Louisiana.

Graybar Electric Co transferred R. H. Lloyd to Seattle as Northwest district appliance sales manager, succeeding N. A. Hayes. Lloyd was former district sales manager at Houston.

Elliott Co opened a new sales office in New Orleans at 256 Lee Circle Building, to service southern Mississippi and Louisiana. Its staff includes G. C. Bayles as manager and C. W. Britt, Jr, both formerly in the Atlanta office. The company also named F. L. Humphrey, Jr, assistant district manager in its Atlanta territory.

Allen-Bradley Co, Milwaukee, named Richard Wessling, formerly vice president and director of Electric Supply Corp, manager of its Chicago office.

Electric Controller & Mfg Co, Cleveland, has named Jack H. Cobb to its Chicago sales staff, and has opened a Buffalo-area office at 675 Main St., East Aurora, N. Y., headed by N. Mark Hodapp, previously located in Syracuse.

Anaconda Wire & Cable Co has named Albert H. Leader manager of its Seattle district office, succeeding Lloyd Wolfe, who retired after 32 years of service.

MANUFACTURERS' EARNINGS

Company	Period Months Ended		Net Income 1954	Net Income 1953	Earnings Per Common Share 1954	Earnings Per Common Share 1953
Brown	12	Nov.	$3,050,696	$4,396,967	$1.04	$1.69
du Pont (E. I.) de Nemours	12	Dec.	235,565,206	224,064,550	4.94(a)	4.70(a)
Electric Storage Battery	12	Dec.	1,698,067*	2,249,376*	1.87	2.48
Elliott	12	Dec.	2,532,971	2,781,799	4.18(a)	5.10(a)
Minnesota Mining & Mfg	12	Dec.	17,977,771	16,089,995	2.14(a)	1.96(a)
Motorola	12	Dec.	7,076,335	7,012,700	3.66	3.62
Okonite	12	Dec.	2,360,000	2,124,000	14.00	12.59(b)
Phelps Dodge	12	Dec.	38,878,733(c)	35,026,550(c)	3.83	3.45
Philco	12	Dec.	18,350,577	11,491,207	4.86	3.15
Sangamo Electric	12	Dec.	1,967,623	2,014,162	2.81	2.88
Square D	12	Dec.	4,135,000	4,486,000	3.01	3.26
			1953	**1952**	**1953**	**1952**
Stone & Webster	12	Dec.	$5,790,848	$6,169,381	$2.75	$2.93
United States Steel	12	Dec.	222,735,556	143,687,746	7.56	4.54

Notes—* Includes credit of $80,000 in 1953 and $705,000 in 1952 representing transfer from reserve for contingencies; (a) Based on shares outstanding at close of the period; (b) Based on shares now outstanding; (c) After depletion of mines.

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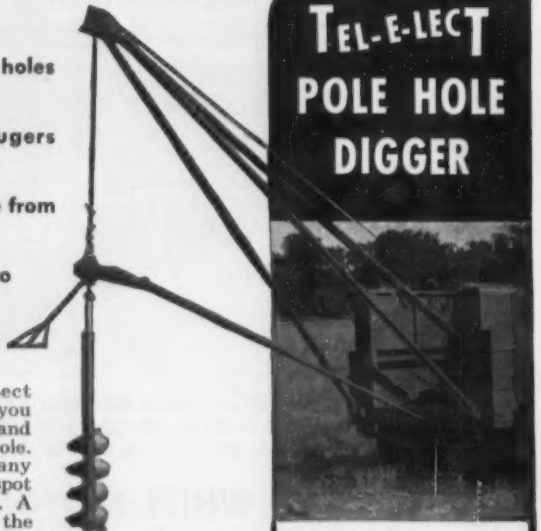

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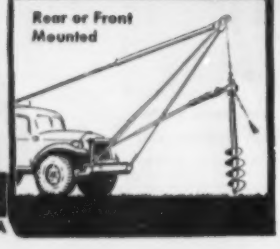

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MEETINGS CALENDAR

North Central Electrical Industries
17th Annual Electrical Industry Convention, Hotel St. Paul, St. Paul, Minn., March 21-24.

Southeastern Electric Exchange
21st Annual Meeting, Boca Raton Hotel, Boca Raton, Fla., March 22-24; Spring Meeting, Engineering and Operation Section, Sans Souci Hotel, Miami Beach, Fla., May 6-7.

Institute of Radio Engineers
1954 National Convention, Waldorf-Astoria Hotel and Kingsbridge Armory, New York, March 22-25.

American Power Conference
Sherman Hotel, Chicago, March 24-26.

Oklahoma Utilities Association
Annual Convention, Biltmore Hotel, Oklahoma City, March 25-26.

***Edison Electric Institute**
Power Station Chemistry Subcommittee of Prime Movers Committee, Deschler Hilton Hotel, Columbus, Ohio, March 29-30; 20th Annual Sales Conference, Edgewater Beach Hotel, Chicago, April 5-8; EEI-AGA Accounting Conference, Hotel Statler, Boston, April 12-14; Industrial Relations Committee, Netherlands Plaza Hotel, Cincinnati, Ohio, April 15; Conference of Public Utility Fleet Operators, Sponsored Jointly by EEI Transportation Committee and AGA Automotive-Mobile Equipment Committee, Mount Royal Hotel, Montreal, Que., April 20-23; Prime Movers Committee, Electrical Equipment Committee, and EEI-AEIC Meter and Service Committees, May 3-4; Hydraulic Power and Transmission-Distribution Committees, May 4-5; All at Edgewater Beach Hotel, Chicago; 22nd Annual Convention, Atlantic City, N. J., June 1-4.

Northwest Public Power Association
Annual Convention, Winthrop Hotel, Tacoma, Wash., March 31-April 1-2; Engineering and Operations Section, Benjamin Franklin Hotel, Seattle, Wash., May 20-21.

***American Institute of Electrical Engineers**
6th Conference of Subcommittee on Rubber-Plastics Industries of Committee on General Industry Applications, Mayflower Hotel, Akron, Ohio, April 5-6; Conference on Feedback Control, Claridge Hotel, Atlantic City, N. J., April 22-23; Northeastern District Meeting, Hotel Van Curler, Schenectady, N. Y., May 5-7; Conference on Telemetering, Morrison Hotel, Chicago, May 24-26; Summer General and Pacific General Meeting, Hotel Biltmore, Los Angeles, June 21-25; Committee on Petroleum, Conference on Electrical Applications in Petroleum Industry, Mayo Hotel, Tulsa, Okla., Sept. 28-29; Fall General Meeting, Chicago, Ill., Oct. 11-15.

American Public Power Association
Annual Meeting, Hotel Morrison, Chicago, May 4-6.

Pennsylvania Electric Association
Systems Operation Committee, Bedford Springs Hotel, Bedford Springs, Pa., May 6-7; Prime Movers Committee, Castleton Hotel, New Castleton, Pa., May 17-18.

National Association of Electrical Distributors
Annual Convention, Atlantic City, N. J., June 6-11; Pacific Zone Convention, Mark Hopkins Hotel, San Francisco, Oct. 4-7.

American Society of Mechanical Engineers
Semi-Annual Meeting, William Penn Hotel, Pittsburgh, June 20-24; Fall Meeting, Schroeder Hotel, Milwaukee, Wis., Sept. 8-10.

World Power Conference
Sectional Meeting, Rio de Janeiro, Brazil, July 25-Aug. 10.

Pan-American Federation of Engineering Societies
(UPADI), Third Convention, Sao Paulo, Brazil, Aug. 2-12.

*Addition this week.

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Ask for Bulletin 271 for outdoor supports.

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81

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Kvar Supply

(*Continued from page* 107)

appreciably. For the high reactance system this question naturally follows: If we cannot normally use the available generator kvar output, why not purchase machines with higher power factor and lower kva ratings?

At steam plants this possibility should be approached with caution. Emergency conditions can require an appreciable increase in kvar generation, new load can develop near the station, and the possible dollar saving is not great. On the other hand hydro developments are almost always at a considerable distance from the load area. And as the slow speed hydro machine is far more expensive than the 1,800 and 3,600 rpm steam machine, 0.90 to 0.95 power factor hydro generators are being used.

6. Emergency Considerations . . . Viewed from the generating station, external system emergencies generally cause an increase in apparent system reactance and/or a reduction in "equivalent system" voltage. In the system of Fig 3, the emergency loss of a circuit causes an appreciable increase in system reactance. This is similar to conditions which can develop in a subtransmission loop supply like Fig 8.

This figure analyzes the emergency voltage conditions for a 34.5-kv, 32-mile loop with a total load of 15,000 kva and asumes that no more than a 10% voltage change is permitted when one section of the loop is lost. The normal voltage drop at point A is 3.3%. If, however, one section of the loop is lost, say (b), the emergency voltage drop at point A becomes 13.3%. A marked emergency voltage improvement can be obtained through the installation of substation or distribution capacitors. This is illustrated by the fact that by adding a total of 5,000 kvar of capacitors, the total load can be increased by 5,000 kva without exceeding the same voltage conditions.

Basically then, whenever kvar generation is transferred from the source station out into the system, there is a tendency to improve emergency voltage conditions. This is illustrated in Fig 9. When the system reactance jumps from 0.4 to 0.6—without any change in either generator terminal voltage or system voltage—an appreciable increase in total kvar loss results. This

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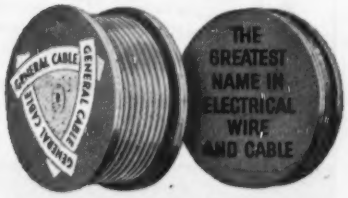

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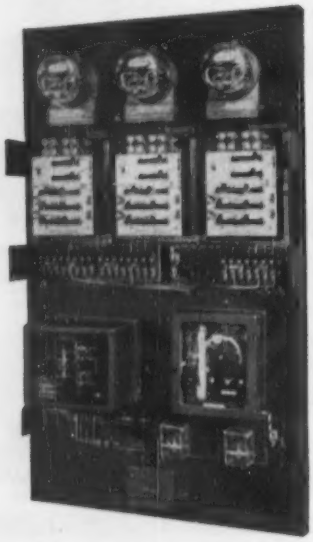

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increase is greatest when the normal kvar supply from the generating station is greatest. Furthermore, if the generating station normal kvar supply is low, it automatically picks up most of the additional kvar loss—leaving only a little additional emergency kvar generation to be supplied by the system.

One corollary point should not be overlooked. That is that the generator voltage regulator becomes an extremely important device. We cannot hold up the generator terminal voltage in this type of emergency unless automatic means are immediately available to increase generator excitation. Otherwise, the generator terminal voltage will fall, and steady state instability may result.

Obviously, if the system for some reason is unable to supply the additional emergency kvars called for by Fig 9, the system voltage drop will be much less whenever the generating station kilovar output is low. For example, with a normal generating station kvar output of 0.30, the system voltage will drop 8% if the generator is required to pick up all additional emergency kvars. On the other hand, if the generator of this system is operated initially at unity power factor, the system voltage drop will be only 1.5% if the generator must furnish all the emergency kilovars. Furthermore, it will be noted in Fig 9 that a cross-over point exists in the leading power factor region, for this system at −0.06 kvars. If the generator were to be operated at this point initially, there would be no change in system voltage, neglecting the influence of circuit resistance, under this type of emergency.

References

"Kilovar Supply and Voltage Control of Subtransmission Systems," C. A. Woodrow, Electrical World, Dec. 4, 1950.

"Underexcited Operation of Turbine Generators," C. G. Adams and J. B. McClure, AIEE Transactions, Vol. 67, Page 521, 1948.

"Auxiliary Power Systems for Steam Electric Generating Stations," A. G. Mellor and R. A. Schmidt, Jr., AIEE Power Apparatus and Systems, December, 1952.

"Low Short-Circuit Ratio is Practical for Today's Turbine Generators," S. B. Crary and J. B. McClure, Electrical World, June 30, 1952.

"System Stability Limitations and Generator Loading," H. C. Anderson, H. O. Simmons, Jr., and C. A. Woodrow, AIEE Power Apparatus and Systems, June, 1953.

Plan Cycle Changeover

• Ontario Hydro Electric Power Commission expects to get the job of converting Toronto from 25 to 60 cycle under way in the west end of the city early next year. While general switchover will not take place until next year, part of Toronto will be converted early this month.

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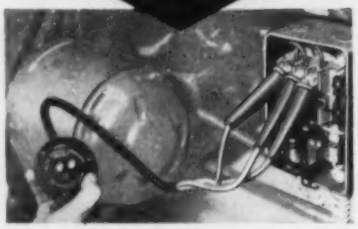

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Power Briefs

(Continued from page 188)

Dam to be built on the Rio Grande by the International Boundary and Water Commission is expected to begin as soon as a $500,000 appropriation is provided by the U. S. Congress. The project, like the Falcon Dam, was authorized by the U. S.-Mexico Water Treaty of 1945.

● Gilbert Associates, Inc, international engineers and business consultants, will take over operation, management and maintenance of the power generating system on Okinawa for the U. S. government, Ryukyus Command, early this year. Hamilton Duncan, vice president of Gilbert Overseas Corp, left recently with a task force of 35 experienced American utility operators who comprise a unit of key personnel to train and supervise activities Okinawa natives in the operation of the power facilities.

● Arkansas Louisiana Gas Co has been granted permission by Federal Power Commission to install new pipe lines to increase service to two Arkansas Power & Light Co plants, which are increasing their capacity. The gas company will construct a 7.8-mile, 8-in. line from the McKamie Field to Harvey C. Couch plant at Stamps, Ark., and a 16-in. half-mile line from the Arkansas River to the Cecil Lynch plant at Rose City, Ark.

New Applications Made to FPC for Permits

Increased interest in private and local development of hydroelectric sites brought three new applications to Federal Power Commission within the last few weeks:

● Public Utility District No. 1 of Chelan County, Wash., asked for a preliminary permit for a proposed three-dam 145,000-kw project on the Chewawa and Wenatchee Rivers in Washington.

● Vermont Electric Cooperative Inc, of Johnson, Vt., asked for a preliminary permit for a proposed 10,000-hp project on the Lamoille River in Franklin County, Vt.

● United Water Conservation District of Santa Paula, Calif., asked for a preliminary license for a proposed 9-dam project on the Piru and Sespe Creeks and their tributaries in California.

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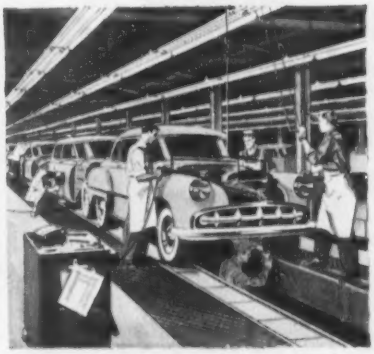

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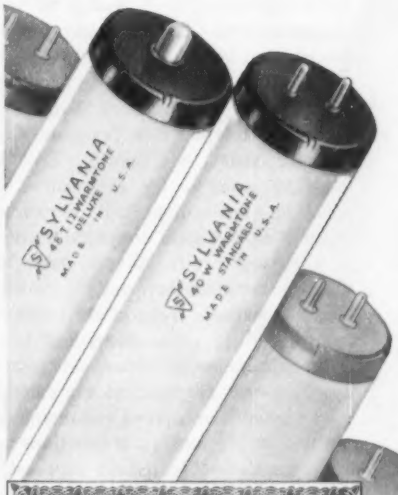

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Fair Value

(Continued from page 118)

ity of such property under the particular rates proposed and the sum required to meet the expenses of such carrier . . . and all other facts that will enable it to determine what are reasonable and just rates, charges and tariffs' G. S. 62-124."

The court then said, "Clearly this (the commission's finding) [parenthesis supplied] was in conflict with the express terms of the standard prescribed by the legislature in G. S. 62-124. The conclusion is inescapable that by accepting the book value as the rate base, it, **ex necessitate,** excluded consideration of present cost of replacement and all other factors from effective consideration."

Fair Value Statute . . . Regarding the North Carolina fair value statute, the court said that "Smyth v Ames, 169 US 466, 42 L ed. 819, is the parent of G. S. 62-124. The language of our statute is lifted almost verbatim out of the opinion in that case."

With respect to the intercorporate relationship of Southern Bell and American Telephone & Telegraph Co, the court stated, significantly, "Strictly speaking what is the fair value of applicant's investment in its intrastate business in this state and what constitutes a fair return thereon are the primary questions before the commission for decision. Yet this corporation operates in 18 other states and is a part of a nationwide system, controlled by one parent corporation, **the capital stock of which occupies a commanding position on the market. It functions as one corporation.** [emphasis supplied]. And, necessarily, its financial condition is affected by the rates charged and income received from its intrastate business in each and every one of the 19 states in which it functions."

The court made it clear that it considered the applicant's financial condition excellent in spite of the fact that its rate of return for the whole company was only 4.8%.

The court then continued: "Since it is at least 5.4% in North Carolina, the net return in some of the other states must be lower than the average. North Carolina users of telephones are not to be required to furnish revenue to maintain applicant's financial condition which other states refuse to provide or to pay at rates materially higher than those charged in other territory served by the same corporation. A substantial differential might be considered some evidence that the rates charged in the state are unreasonable and unjust to the local public."

The court again mentioned the relationship of Southern Bell and AT&T when it said, "But these factors (the ability to attract capital [parenthesis supplied] are of little moment here, for the applicant has available at all times a fund provided by its parent company from which it may borrow at will for needed improvements or enlargements. Under the circumstances here disclosed, what it has to pay for its borrowings from this fund is of more importance."

Economic Depreciation . . . As to the economic depreciation, the court, in referring to the lower court's decision to approve economic depreciation said, "It is apparent the parties construe this instruction (to find economic depreciation [parenthesis supplied] to mean that the current rather than the cost value shall be the basis for estimating depreciation allowances. If this is the correct interpretation of the language used by the trial judge, the instruction must be held for error."

It concluded " . . . if the rate of depreciation allowed for rate-making purposes is in excess of the investment currently consumed, over and above maintenance costs, it is unfair to the public, for then the company is permitted to recover annually a part of its investment which is not currently consumed."

Again in referring to the allowable rate of return, the court said, "The former allowance of a 6.50% rate of return is not **res-judicata,** barring the commission from fixing a lesser rate in this proceeding. Nor is the commission compelled to provide a 6% rate of return which, under present conditions, may be considered by some a high rate for a corporation that is in effect assured a 'reasonable and just' rate on its investment in good times and bad. It is only required to fix rates that are reasonable and just under the conditions as they now exist. And when it fixes a schedule of rates under the standard prescribed by the legislature which is within the bounds of reason, it is as binding upon courts as it is upon interested parties.

"Presently we are not prepared to say that a net return of 5.40%—over and above all taxes—is inadequate. That is for the PUC to decide."

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● **GE BULLETINS:** The following seven booklets are available from General Electric Co, 1 River Rd, Schenectady 5, N. Y.:

GEA-5779B Oil-tight, push buttons, indicating lights, selector switches, and accessories—16 pages

GEA-5712A Multiple-generator sectional drives for paper machines—8 pages

GEA-6061 Magnetic and manual motor starters, combination starters, and magnetic reversing controllers—6 pages

GEA-6067 L-69 floodlight for sports lighting applications—8 pages

GEA-5923 Dynamometer systems—12 pages

GEA-6034 Steel-mill drive engineering—16 pages

● **WESTINGHOUSE BULLETINS:** The following two bulletins are available from Westinghouse Electric Corp, P. O. Box 2099, Pittsburgh 30, Pa.:

B-6134 Large distribution transformers rated from 250 to 500 kva—8 pages

TD 52-601 Current and potential transductor magnetic amplifiers for instrumentation and control—8 pages

● **GROUND RODS:** This one-page bulletin gives new prices of copper-bonded ground rods. Jasper Blackburn Corp, 35 Madison St, St. Louis 6, Mo.

● **HONEYWELL BULLETINS:** The following two bulletins are available from Minneapolis-Honeywell Regulator Co, Wayne & Windrim Ave, Philadelphia 44, Pa.:

Data Sheet 10.0-14 High impedance input instrument for source impedances from 0 to 50,000 ohms—2 pages

Catalog 6709 Remote bulb thermometers; recorders and indicators; pneumatic, electric, and program control; psychrometers; bulbs; tubing; and fittings—44 pages

● **RADIO EQUIPMENT:** A four-page folder describes push-button and dial-operated selective calling equipment for individually controlling radio-equipped vehicles. Hammarlund Manufacturing Co, 460 W. 34th St, New York 1, N. Y.

● **LIGHTING UNITS:** A 16-page booklet, Folio P-54, covers a variety of plexiglas fluorescent lighting units. Gruber Lighting, 125 S. First St, Brooklyn 11, N. Y.

● **VIBRATION MOUNTS:** Bulletin 537, 4 pages, presents technical and application information on Series 262 and 633 vibration isolators. Barry Corp, Watertown, Mass.

● **INDUSTRIAL INSTRUMENTS:** Bulletin F 5633-1, 4 pages, describes a line of Wheelco instruments for industrial process control applications. Barber-Colman Co, 1300 Rock St, Rockford, Ill.

● **CONDUCTIVITY TESTER:** Bulletin 2B, 4 pages, describes Model 269 conductivity tester for hazardous atmospheres. Associated Research, Inc, 3760 W. Belmont Ave, Chicago 18, Ill.

● **TRACTOR-SHOVEL:** Form No. 262, 8 pages, shows by means of on-the-job photographs uses of Payloader tractor-shovels. Frank G. Hough Co, Libertyville, Ill.

● **CABLE SHEETS:** Revised and additional sheets are available for "Aluminum Cable, Steel Reinforced . . . ACSR". Reynolds Metals Co, 2500 S. Third St, Louisville 1, Ky.

● **SYNCHRONOUS MOTORS:** Bulletin 05B8008, 4 pages, describes standard construction features of engine-type, low-speed, synchronous motors in ratings of 100 hp and larger at speeds of 450 rpm or less. Allis-Chalmers Manufacturing Co, 932 S. 70th St, Milwaukee, Wis.

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☐ **Check contents** and locations of first-aid kits. Be sure they're adequate and up to date. Here, again, your CD Director can help. He'll advise you on supplies needed for injuries due to blast, radiation, etc.

☐ **Encourage personnel** to attend Red Cross First-Aid Training Courses. They may save your life.

☐ **Encourage your staff** and your community to have their homes prepared. Run ads in your plant paper, in local newspapers, over TV and radio, on bulletin boards. Your CD Director can show you ads and official CD films or literature that you can sponsor locally. Set the standard of preparedness in your plant city. There's no better way of building prestige and good community relations—and no greater way of helping America.

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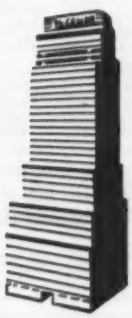

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400	West.	HG	1.0	900
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1	—1000	Moore	Condensing—Extraction—190 lbs., 2400—3—60—Surface Cond.
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1	—750	Whse.	900	275	2300/4150
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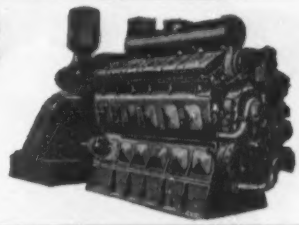

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1100	General Motors	16-278A	1600	720	320	Enterprise	D6G-6	560	450
750	General Motors	12-567	1080	720	300	General Motors	8-268A	450	1200
700	Worthington	EE-8	1000	327	200	General Motors	8-268A	350	900
500	General Motors	8-278A	750	720	150	Worthington	CC-4	225	450
500	General Motors	8-567	720	720	150	Ingersoll-Rand	S-4	225	600
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2— 750 KVA G.E., 3 Ph., 4150V. 120/240V. sec.
2— 750 KVA G.E., 1 Ph., 4600V. 115/230
2— 400 KVA Pitts., 1 Ph., 2400/4800V. 240/48V.
1— 333 KVA Whse., 1 Ph., 2400V. 600 V. sec.
2— 300 KVA G.E., 1 Ph., 13200V. 220/440V.
1— 200 KVA G.E., 3 Ph., 2400-220 sec.
3— 200 KVA G.E., 1 Ph., 13200V. 440V.
1— 200 KVA G.E., 3 Ph. 4150V., 3 Ph. 2400V., Auto.

SYNCHRONOUS MOTORS

1— 300 H.P., Elec. Mach., 720 RPM. 3 Phase 60 cys., 2200V T E F Cooled Outdoor service.
1— 150 H.P., G.E., 1880 RPM. 220V. 3/60.
2— 150 H.P., Al. Chal. 360 RPM. 440V. 3/60.

MOTOR GENERATOR SETS

1—1000 KW Whse., 600 V. 720 RPM. 4000 Syn.
1—1000 KW G.E., 600 V. 514 RPM. 4000 Syn.
1—1000 KW Whse., 275 V. 720 RPM. 4000 Syn.
1— 200 KW Whse., 250V., 900 RPM. 4000V. Syn.
1— 150 KW G.E., 126/250V. 1200 RPM. 2300 Syn.
1— 100 KW G.E., 250V. 900 RPM. 2300V. Syn.

SLIP RING MOTORS

2— 500 H.P., G.E., M 1200 RPM 2400 V.
1— 400 H.P., West., CW. 450 RPM. 550V.
1— 250 H.P., West., CW. 600 RPM. 440V.
1— 200 H.P., West., CW. 900 RPM. 440V.
3— 150 H.P., Al. Ch. 1800 RPM. 2300V., 3PH. 60 Cy.

Large Stock of A.C. and D.C. Equipment

TRANSFORMERS

BOUGHT AND SOLD

We carry a large stock of rebuilt and guaranteed transformers, and invite your inquiries.

Custom-built transformers and coils manufactured to your specifications.

Expert Repair Service—all makes and sizes of transformers rewound, repaired and redesigned.

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40 Years' Dependable Service

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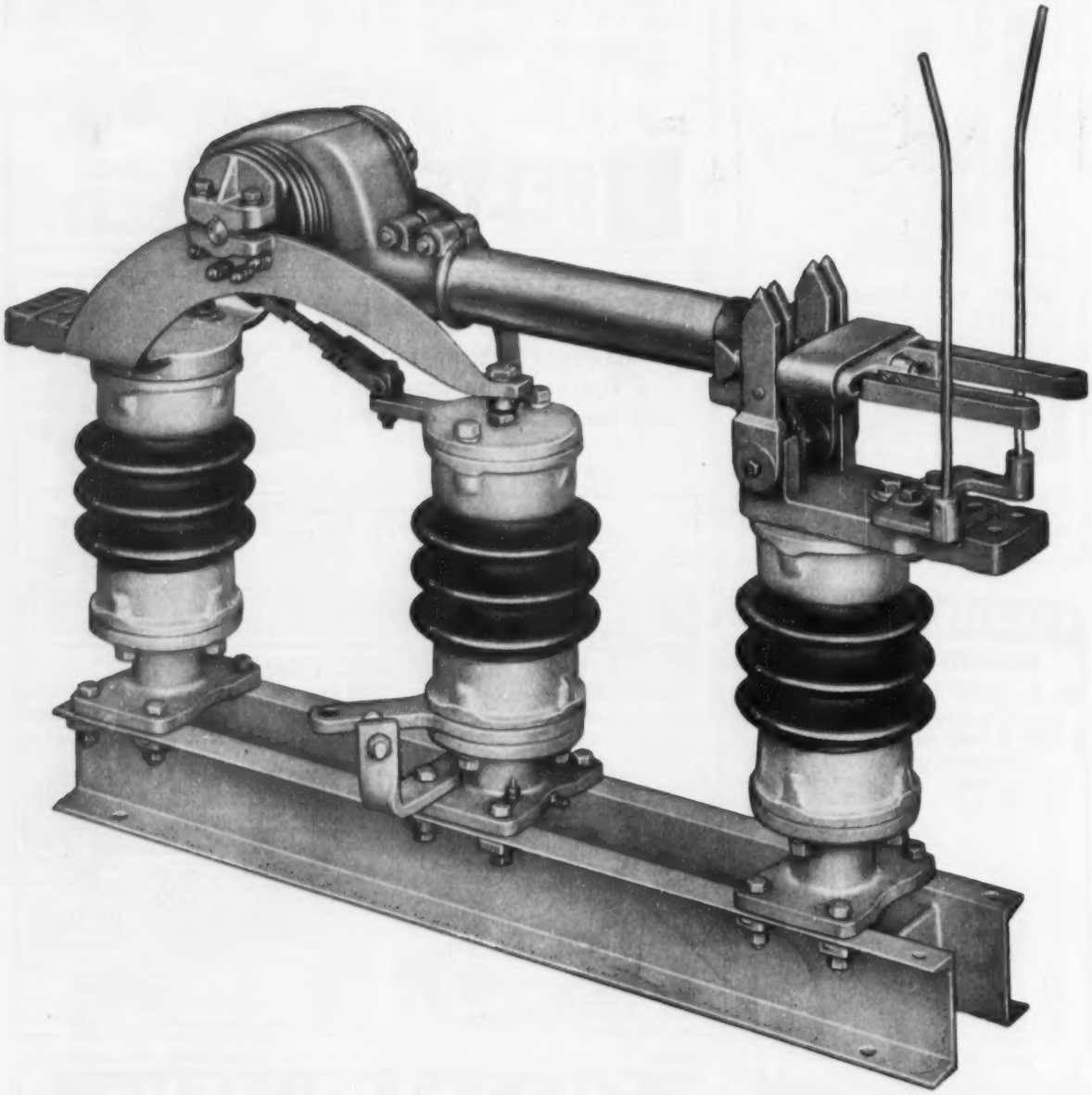


AIR BREAK DISCONNECTING SWITCH

7,500 Volts—2,000 Amperes—Type 0-2

Vertical break. Three pole. Single throw. Group operated.

One Pole Shown.

SILVER TO SILVER CONTACTS

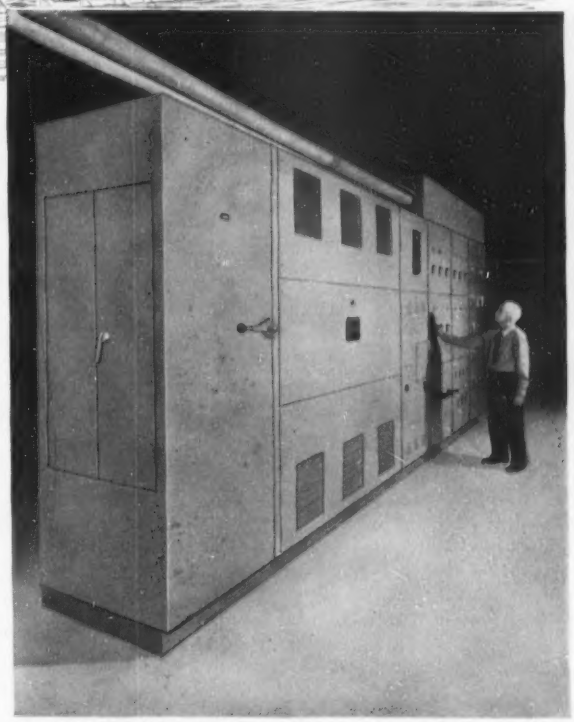
FEDERAL NOARK® POWER CENTER... THE WINNER AT LAUREL!

IT TAKES ELECTRICITY to operate a race track. Without electricity you'd have trouble buying an admission ticket or placing a bet . . . and how could the horses get through the gates or give you a photofinish? Well, Laurel, in Maryland, is today's most modern track, and its electrical system is controlled by Federal Noark main service equipment, lighting and power panels, motor controls, control centers and a unit substation.

Federal Noark equipment is today's best answer in buildings of every type and wherever else there's an electric light and power control problem. Most of this equipment is factory-assembled from standard units to meet individual specifications. All of it brings minimum installation costs . . . and is designed for maximum efficiency, easiest maintenance and remarkable flexibility for later changes or expansion.

Next time you have an electrical distribution problem, pass it on to Federal Noark for the most practical and economical solution.

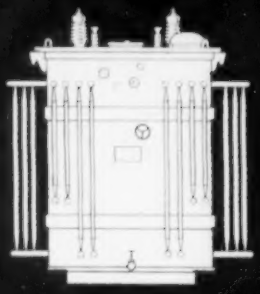
FEDERAL ELECTRIC PRODUCTS COMPANY
50 PARIS STREET, NEWARK 5, N. J.



Federal Noark Power Center at Laurel Race Course. Factory-assembled and tested. Circuit breakers completely interlocked in all positions . . . high voltage switches coordinated with power fuses. Complete sectionalizing between high and low voltage and individual breakers makes maintenance safe and easy. On the complete Laurel electrical system, Architect was Arthur Froehlich, Beverly Hills, California; Contractor, Harry S. Mickey, Baltimore, Maryland.

Federal Noark products: Stab-lok Circuit Breakers, Motor Controls, Safety Switches, Service Equipment, Industrial Circuit Breakers, Panelboards, Switchboards, Control Centers, Bus Duct — **Pacific Electric Manufacturing Corporation products:** High voltage circuit breakers and power switches ★ Sales offices in principal cities.

FEDERAL NOARK®



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ENGINEERED TO WITHSTAND
HIGH OPERATIONAL STRESSES

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